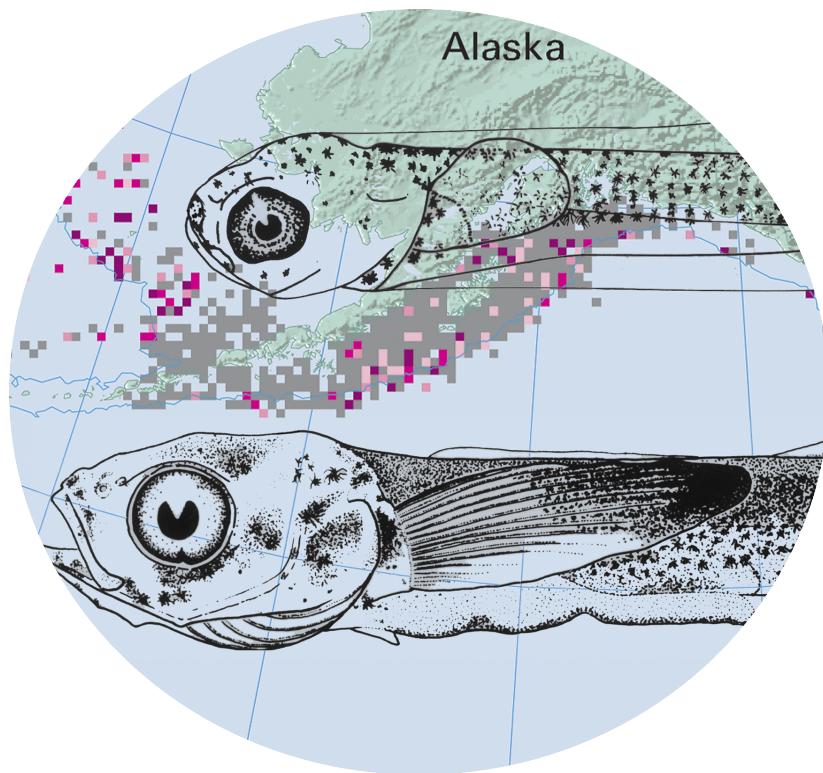


A Taxonomic Guide and Atlas for the Early Life History Stages of Northeast Pacific Fishes

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Contents

| | |
|--|------|
| Acknowledgements | iii |
| Introduction | 1 |
| Background and Historical Review | 2 |
| Recruitment Processes Program Ichthyoplankton Sampling Studies | 2 |
| Ongoing Investigations | 2 |
| Geographic and Temporal Coverage | 3 |
| Overview of the Physical Oceanographic Environment | 3 |
| Information and Data Sources | 5 |
| Sampling Protocol | 5 |
| Geographic Coverage | 5 |
| Taxonomic Coverage | 6 |
| Format and Methods | 7 |
| Statistical Overview for Map Generation | 7 |
| Data Layers | 7 |
| Occurrence Map Generation | 7 |
| Appendices | 8 |
| Appendix A - Figures | 8 |
| Appendix B - Maps | 18 |
| Appendix C - Tables | 28 |
| References | 62 |
| Taxon Accounts | 66 |
| Citations | 1218 |
| Phylogenetic Species Index | 1252 |
| Alphabetical Species Index | 1257 |
| Common Name Species Index | 1262 |

Acknowledgements

Several years ago, it became apparent that our taxonomic guide to the early life history stages of Northeast Pacific and Bering Sea fishes published in 1989 was in need of updating. At the same time, we were completing our companion atlas on the distribution and abundance of the early life history stages of fishes collected from the same geographic area. Faced with the daunting task of yet another large volume years in the making, we met and discussed alternative options. The results of our brainstorming are the Ichthyoplankton Information System (IIS): timely, searchable, printable and easily updated.

We thank those involved in getting this project off the ground for financial support, but more importantly for their vision and willingness to embrace change and creativity: Jeff Napp (Recruitment Processes (RP) Program Manager), Gary Stauffer (former Resource Assessment Conservation Engineering (RACE) Division Director) and Russ Nelson (current RACE Division Director). Art Kendall (retired) and Lisa Rugen (formerly Alaska Fisheries Science Center (AFSC)) developed a rockfish database several years ago that served as a model for concept and design. This project could never have been accomplished without the labor-intensive work done by students Erin MacDonald, Margarita Reimer, and Pamela Woods, under the direction of Ted Pietsch, through several contracts with the University of Washington Fish Collection (UWFC). Erin was part of the

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Introduction

The Recruitment Processes Program at NOAA's Alaska Fisheries Science Center (AFSC) has been collecting ichthyoplankton in the Northeast Pacific and Bering Sea since the early 1970s, yielding an invaluable collection of specimens and a comprehensive dataset of locality, distribution, and abundance information for the early-life-history (ELH) stages of fishes in the area. This work led to the publication of a taxonomic guide to the identification of the eggs and larvae of >200 species of fishes (Matarese et al., 1989) and an atlas that presents data on spatial and temporal trends in the dominant fish eggs and larvae (Matarese et al., 2003). The consolidation of data (updated from the taxonomic guide, atlas, and associated metadata) from these sources form the backbone of the Ichthyoplankton Information System (IIS). The IIS is an online, interactive, searchable information system that is routinely updated to include the most current publications. The IIS consolidates almost 40 years of fish ELH data representing almost 300 taxa into a single website that is accessible to everyone. The IIS is an invaluable tool providing the most up-to-date information on the ELH of fishes in the Northeast Pacific and Bering Sea, including some of the most diverse and commercially valuable ecosystems in the world.

Background and Historical Review

Recruitment Processes Program Ichthyoplankton Sampling Studies

(for a complete discussion see Matarese et al., 2003).

The Recruitment Processes Program has been collecting and analyzing ichthyoplankton for almost 40 years (Fig. 1, Appendix A). Beginning in 1965, AFSC, then known as the Bureau of Commercial Fisheries (BCF) Seattle Biological Laboratory, started an ichthyoplankton program off the Northeast Pacific coast to determine the northernmost extent of *Merluccius productus* (Pacific hake) spawning. Only data on Pacific hake were kept and analyzed. The Marine Resources Monitoring, Assessment, and Prediction Program (MARMAP) began in 1971, sampling in the eastern Bering Sea, off Kodiak Island, Alaska, and off Vancouver Island, British Columbia. Samples were collected using MARMAP standard protocol (Jossi and Marak, 1983) and all taxa were sorted, counted, and identified by larval taxonomists at the Seattle laboratory, at that time known as the Northwest Fisheries Center (NWFC). The Outer Continental Shelf Environmental Assessment Program (OCSEAP) supported five cruises conducted 1977-1979 in the shelf waters east of Kodiak Island in the Gulf of Alaska. These studies were developed to assess the spatial and temporal distribution of plankton that might be affected by oil exploration and development. In 1980, the Plankton Sorting and Identification Laboratory in Szczecin, Poland, began processing ichthyoplankton samples collected by our center, which had been renamed the Northwest and Alaska Fisheries Center (NWAFC) in 1974. For most of the early 1980s, sampling was conducted along the Washington, Oregon, and northern California coasts in cooperation with the Soviet Union (USSR/USA cruises, 1980-87). As the first large-scale ichthyoplankton surveys to be done in this region, this work sought to document patterns in occurrence, distribution, and abundance of ichthyoplankton in coastal waters of the Northeast Pacific. The Fisheries Oceanography Coordinated Investigations (FOCI) Program began in 1985 and was initially centered on physical and biological factors affecting survival of ELH stages of walleye pollock (*Theragra chalcogramma*) in the Gulf of Alaska. Bering Sea FOCI was established in 1991 (after the NWAFC was split into two centers, the Northwest Fisheries Science Center (NWFSC) and the AFSC) under the auspices of NOAA's Coastal Ocean Program (COP) to address similar research in the eastern Bering Sea shelf region. Bering Sea FOCI ended in 1996, but was immediately followed in 1997 by the Southeast Bering Sea Carrying Capacity Program (SEBSCC), also sponsored by COP. This program sought to document the role of juvenile walleye pollock in the eastern Bering Sea ecosystem, to examine the factors affecting their survival, and to develop and test annual indices of prerecruitment abundance (Dagg and Royer, 2002). The Northeast Pacific Global Ocean Ecosystems Dynamics Program (GLOBEC) was added to the Recruitment Processes Program in 1998. The GLOBEC research, in addition to compiling a comprehensive atlas that presents data on spatial and temporal trends in the dominant fish eggs and larvae (Matarese et al., 2003), includes studies comparing multi-species ichthyoplankton assemblages from the Gulf of Alaska, Bering Sea, and U.S. west coast (Doyle et al., 2002a; Doyle et al., in prep.) and larval flatfish transport studies, concentrating on the influence of El Niño in the Gulf of Alaska (Bailey and Picquelle, 2002). These investigations have provided insight into the spawning strategies of the fish populations in these regions and how they relate to oceanographic conditions.

Ongoing Investigations

Over the years, the Recruitment Processes program has broadened its focus from single species studies to a more holistic ecosystem approach. FOCI, one of our original projects, became so broad that this acronym was being used as the "umbrella" for many different projects. To reflect this broadening of our investigations, the group recently agreed to put all existing and future projects under the Eco-FOCI acronym (Ecosystem & Fishery-Oceanography Coordinated Investigations). This evolution occurred as NOAA Fisheries was also broadening its focus and adopting an ecosystem approach to management. One of our newest projects that is a perfect fit for Eco-FOCI is the North Pacific Climate Regimes and Ecosystem Productivity project (NPCREP), which seeks to observe and understand how climate determines the structure and function of marine ecosystems (Bering Sea and Gulf of Alaska). This new project, in collaboration with NOAA's Pacific Marine Environmental Laboratory, will also apply our new knowledge of climate-ecosystem linkages to the management of living marine resources, as does our original FOCI program.

Our original FOCI studies on walleye pollock and their ecosystem continue in the Gulf of Alaska and the eastern Bering Sea. For the Gulf of Alaska, FOCI conducts process studies and annual larval surveys and incorporates these data into recruitment estimates for walleye pollock (Megrey et al., 1996; Bailey, 2002). Correlation modeling methods have been developed to analyze hydroacoustic survey results of spawning aggregations, ichthyoplankton surveys of larvae, estimates of spawning biomass and recruitment from annual stock assessment, measurements of ocean temperature, winds, rainfall, sea-level pressure gradient, and other biological and physical factors (Megrey et al., 1995). Studies in the Bering Sea continue to document the role of walleye pollock in the eastern Bering Sea ecosystem, including their interaction with seabirds and marine mammals.

GLOBEC-supported investigations have identified dominant taxa and multispecies assemblages in the ichthyoplankton, described their horizontal distribution patterns, and related these patterns to the oceanographic variables (Doyle et al., 2002a). Temporal variation in the composition, distribution, and abundance of these assemblages is being further investigated. In addition, we are examining temporal variability in the occurrence, abundance, and distribution of many ichthyoplankton species that are numerically dominant (e.g. *Hippoglossoides elassodon*, flathead sole, Porter, 2005; *Lepidotsetta polyxystra*, northern rock sole, Lanksbury et al., 2007; *Atheresthes stomias*, arrowtooth flounder, Blood et al., 2007) and ecologically important (e.g., *Mallotus villosus*, capelin, Doyle et al., 2002b). Seasonal ichthyoplankton assemblages are being identified and described (e.g., summer ichthyoplankton in the Bering Sea, Duffy-Anderson, 2006; fall ichthyoplankton in the Gulf of Alaska, Lanksbury et al., 2005). Other studies are also investigating advective processes associated with onshore transport of ichthyoplankton, developing cross-shelf exchange tracers composed of offshore ichthyoplankton assemblages, and identifying key species that may be indicators of changes in oceanographic conditions or cross-shelf flow.

Background and Historical Review

Geographic and Temporal Coverage (Fig. 2, Appendix A)

Most data for the initial BCF Pacific hake and MARMAP studies in the mid-1960s and early 1970s were not entered into a permanent database. Our database became more consistent in 1977 with OCSEAP, the first broad-scale program offering NWAFC scientists the opportunity to study seasonal occurrences of eggs and larvae in the Northeast Pacific Ocean. During the 1970s, sampling intensity was highest in the Gulf of Alaska east of Kodiak Island (Map 1, Appendix B). The OCSEAP Program offered broad monthly coverage (February-November), but, overall, only 16 cruises were conducted between 1972 and 1979 (no cruises from 1973 to 1976). The graphs adjacent to each map show that the sampling effort over the months of the year varied by decade and by region. In the 1970s, comparatively few cruises were conducted, but most (81%) were conducted in the Gulf of Alaska with the remainder in the Bering Sea.

By the mid-1980s, there was a dramatic increase in the number of surveys due to the addition of U.S. west coast cruises (USSR/USA, 1980-1987) and the initiation of the FOCI Program (Map 2, Appendix B). Sampling was greatest in the Gulf of Alaska in Shelikof Strait and southwest of Kodiak Island. The number of cruises increased from 16 during the 1970s to 49 during the 1980s. January was included in the monthly coverage, but 88% of cruises occurred from March to May, which is the peak period of walleye pollock spawning in Shelikof Strait. Only four cruises were conducted in the Bering Sea, but coverage was expanded with nine cruises conducted along the U.S. west coast. Sampling distribution along the west coast was highest along the continental shelf region from Washington to northern California, while sampling was limited nearshore and in the deeper offshore waters.

Coverage in the 1990s (1990-1996) was expanded to include more sampling in the Bering Sea with the onset of the Bering Sea FOCI and SEBSCC Programs (Map 3, Appendix B). More cruises were conducted than in the 1980s (58 versus 49) and a much higher percentage of Bering Sea cruises were conducted than ever before (46%). Summer coverage (27%) was also more extensive. Sampling gear other than bongo and neuston nets and Tucker trawls was used (e.g., MOCNESS nets to assess fine-scale vertical distribution) and cruises using Methot nets were designed to collect early juveniles; however, these special purpose gears were not included in the abundance and distribution data presented here. Coverage since 1996 has continued to focus in the Bering Sea.

Overview of the Physical Oceanographic Environment

The abundance patterns of ichthyoplankton are summarized for three major ecosystems: the eastern Bering Sea (EBS), western Gulf of Alaska (GOA), and the U.S. west coast. An overall description of the physical and oceanographic characteristics of these three ecosystems is summarized below (Doyle et al., 2002a; Matarese et al., 2003).

The eastern Bering Sea is characterized by an exceptionally broad (>500 km) shelf region with a narrow continental slope adjoining an extensive Aleutian Basin (Map 4, Appendix B).

The EBS shelf is one of the most productive regions in the world and sustains a high biomass of higher trophic level organisms (Loughlin et al., 1999). Circulation in the basin is generally cyclonic and is fed by inflow from the Alaskan Stream through the Aleutian Islands (Schumacher and Stabeno, 1998) (Map 5, Appendix B). Flow is greatest in the Bering Slope Current, which transports nutrients onto the outer shelf. Flow over the shelf itself is generally weak and large eddies are a common feature. Ice covers a substantial portion of the EBS each winter and spring, although there is considerable interannual variation in the duration and extent of ice coverage. There are three recognized biophysical domains on the shelf, separated by frontal boundaries at roughly the 50 m, 100 m, and 200 m isobaths, which differ hydrographically depending on the degree of stratification and mixing. Productivity appears to be highest at the shelf-break front and phytoplankton blooms there can begin in May and last throughout the summer (Springer et al., 1996). Zooplankton production is estimated to be highest along the shelf edge and outer shelf where the mesozooplankton consists primarily of large oceanic copepod species.

Numerous troughs and shallow banks characterize the topography of the western Gulf of Alaska. The Aleutian shelf area, as defined by the 200 m isobath, is narrower than the EBS shelf (65-175 km) and drops abruptly to depths of 5000-6000 m in the Aleutian Trench, which parallels the shelf edge (Map 4, Appendix B). The Alaskan Stream, which flows southwesterly and roughly parallel to the shelf break at 50-100 cm/sec, dominates offshore, near-surface circulation (Map 5, Appendix B). Nearshore, the Alaska Coastal Current (ACC) is the dominant feature (Reed and Schumacher, 1986). The upper layer flows in a southwesterly direction. With surface speeds of 25-100 cm/sec, the ACC in the vicinity of Shelikof Strait is one of the most vigorous and dynamic coastal currents in the world (Stabeno et al., 1995). Temperatures follow a clear seasonal pattern, with the coldest values occurring in March and the warmest values in August (Reed and Schumacher, 1986). Freshwater discharge into coastal waters peaks in the fall and strongly affects the circulation (Royer, 1998). This region has been referred to as the Coastal Downwelling Domain and is characterized by mainly onshore flow at the surface (Ware and McFarlane, 1989). A seasonal peak in phytoplankton production occurs first in the ACC, and then in the adjacent shelf area, during the first week in May (Napp et al., 1996). Production of copepod nauplii and other zooplankton usually accelerates significantly at this time, but, because of low temperatures and low concentrations of gravid adults, does not reach a maximum until mid-summer (Cooney, 19

In contrast to the EBS and the western GOA, the continental shelf is narrow off the U.S. west coast (Map 6, Appendix B). Off Washington and northern Oregon, the shelf width is less than 70 km, whereas off southern Oregon and northern California it narrows to less than 30 km, reaching a minimum of about 10 km off Cape Mendocino. A series of submarine canyons transect the shelf and slope off Washington and California.

These canyons are absent off Oregon where rocky submarine banks are found along the shelf. The U.S. west coast is part of an extensive Coastal Upwelling Domain extending from Baja California to southern British Columbia (Ware and McFarlane, 1989). The oceanography of this region is characterized by the California Current system, a typical eastern boundary current regime (Hickey, 1989; 1998) (Map 5, Appendix B).

Background and Historical Review

The main California Current proceeds southwards along the U.S. west coast and is slow, meandering, broad, and indistinct. Prevailing winds cause downwelling close to the coast in winter and upwelling of cold, nutrient-laden, oceanic water close to the coast in summer. The intensity of Ekman transport and associated upwelling is variable along the coast and tends to increase from north to south with a local maximum at Cape Mendocino off northern California (Parrish et al., 1981). Annual sea-surface temperature minimums and salinity maximums generally occur in summer after sustained upwelling-favorable winds. Phytoplankton blooms occur during relaxed upwelling conditions between peak upwelling periods during spring and fall (Small and Menzies, 1981). A zone of high zooplankton standing stock is generally observed 10-30 km offshore in summer and the community is dominated by copepods (Landry and Lorenzen, 1989).

Information and Data Sources

Sampling Protocol

The taxonomic data used in this website were obtained from eggs and larvae collected during ichthyoplankton surveys conducted from 1972 to 2002 by the Recruitment Processes Program (Table 1, Appendix C). Data on distribution and abundance of eggs and larvae were based on surveys from 1972-2002, excluding 1973-1976. Collection data for cruises conducted up to 1988 can be found in Dunn and Rugen (1989), and in the AFSC ichthyoplankton cruise database (Rugen, 2008) for those cruises conducted from 1989 to 2002. The majority of the data are from samples collected using a MARMAP type bongo sampler (Posgay and Marak, 1980) with an inside diameter of 60 cm and a 0.333 or 0.505-mm mesh net. Before 1985, standard MARMAP oblique tows were made to 200 m following MARMAP sampling procedures (Smith and Richardson 1977). In 1985, sampling depth in the Gulf of Alaska was changed to near bottom in order to accurately determine the abundance of walleye pollock eggs and early larvae. Beginning in the early 1990s, annual larval surveys in the Gulf of Alaska began to sample to 100 m in late May because that is where the larvae are most abundant. Flowmeters suspended in the mouths of the nets of all ichthyoplankton gear were used to determine the volume of water filtered by each net. Data from 1-m Tucker trawls were used only for cruises in which Tucker trawls were the primary gear (11 cruises, 779 tows; Table 1, Appendix C).

A Sameoto neuston sampler (Sameoto and Jaroszyinski, 1969), with a mouth opening 0.3 m high x 0.5 m wide and a 0.505-mm mesh net, was used sporadically throughout the time series to collect eggs and larvae that reside in the upper surface waters. A partial summary and analysis of our spring neuston collections from the Gulf of Alaska (1981-1986) are presented by Doyle et al. (1995). A summary and analysis of our neuston collections off the U.S. west coast are presented by Doyle (1992). In comparison to bongo collections presented here (Table 1, Appendix C), Table 2 (Appendix C) presents an overall summary, based on the standard data set for 1972-1996, of the 20 most common taxa collected with neuston gear and arranged by percent frequency of occurrence. Data from the neuston tows were selected to generate maps and graphs for 10 taxa for which the best geographic distribution pattern was described using surface gear (Table 3, Appendix C).

The sampled population is defined as fish in the size range that is effectively caught by the sampling gear, and may include both larvae and juveniles because the transformation point between these two stages is unknown for many species, and because fish were staged inconsistently over the years. The number of individuals caught in each of the three sampling gears (i.e., bongo net, neuston net, and Tucker trawl) was standardized to number caught per 10 m^2 of surface area. Catches from bongo and Tucker gear were standardized based on net mouth area and tow depth and length (Smith and Richardson, 1977). Some of the Tucker tows were depth stratified; that is, two nets sampled two contiguous depth intervals. In these cases, the catches per 10 m^2 from both nets were summed to integrate over the depths sampled by both nets. Since both gears were fished at similar depth ranges, we assumed that bongo and Tucker gear sample essentially the same population, and thus allowed data from these two gears to be combined. This assumption is supported by Shima and Bailey (1994), who concluded that the fish-length-specific sampling effectiveness of these two

gears is not significantly different. It was also assumed that no individuals occurred below the depth sampled by the gear, thus the number caught per 10 m^2 of surface area represents the total number of individuals in the water column below a surface area of 10 m^2 . Samples collected by neuston gear were standardized to number caught per 10 m^2 of surface area based on net mouth width and tow length. Neuston data are usually represented as number per 1000 m^3 , but we chose to scale the data to surface area because that describes the number of animals in a specified area of the neuston layer. In comparing neuston catches and bongo catches per unit area, the neuston catches are much smaller because the volume of water filtered is much smaller. The neuston net effectively samples the top 15 cm of the surface layer; hence animals occurring below this depth are not sampled. It was assumed that most individuals of neustonic species occur in the top 15 cm, although many species migrate vertically in and out of the neuston.

Plankton samples were preserved in the field using a 5% formalin-seawater solution buffered with calcium carbonate chips or sodium borate; after 1983, fish larvae were transferred to 70% ethanol after formalin fixation. All fish eggs, larvae, and juveniles have been removed and identified to the lowest possible taxon since 1980 at the Plankton Sorting and Identification Center in Szczecin, Poland (Fig. 1, Appendix A). Identifications are verified by the taxonomic team at AFSC using information found in Matarese et al. (1989) and supplemented by a number of more recent publications including those by Moser (1996), Busby (1998), and Orr and Matarese (2000).

Geographic Coverage

The study area extends from the Bering Sea, into the Gulf of Alaska, and along the U.S. west coast (Map 7, Appendix B). Most of the sampling throughout the time series occurred in Shelikof Strait and west toward the sea valley and along the Alaskan Peninsula (Map 8, Appendix B). Repeated sampling was more extensive with bongo/Tucker gear than with neuston gear (Map 9 and Map 10, Appendix B). Coverage is most complete in the Gulf of Alaska (except for 1980 when no sampling occurred there; Fig. 2, Appendix A) and less extensive in the Bering Sea and off the U.S. west coast. Coverage is also more complete along shelf regions and less extensive in deeper ocean waters where mesopelagic and deepwater flatfishes spawn. No ichthyoplankton sampling occurred in the North Pacific in Canadian waters. Most of the 625 km^2 grid cells were sampled 1-10 times.

Most of the data used in this study were obtained from bongo tows taken during April and May. Combined bongo tows and Tucker trawls during these two months account for 52-79% of the yearly total, depending on geographic region (Fig. 3, Appendix A). Data from neuston tows were more evenly distributed throughout the year, with tows made during April and May accounting for 0-54% of the yearly total in each region (Fig. 3, Appendix A). The distribution of combined bongo tows/Tucker trawls and neuston tows by year and geographic region further illustrates our extensive coverage of the Gulf of Alaska during the 11-yr period (1977-1987) of routine sampling with neuston gear (Fig. 4, Appendix A).

Information and Data Sources

Taxonomic Coverage (Matarese et al., 1989; Matarese et al., 2003)

The increase in our taxonomic knowledge over almost 40 years has allowed our basic knowledge of the early life history of species to be expanded and fine-tuned. Of the 646 known fish species that occur in the Northeast Pacific Ocean and Bering Sea, we can currently identify a portion of the early life history stages for about 320 (pers. commun., Busby unpubl.). The order of higher taxa generally follows Nelson (1994); genera and species are listed alphabetically within families.

Larvae -- Most of the larvae included in the IIS can be found in our laboratory guide (Matarese et al., 1989), atlas (Matarese et al., 2003), or CalCOFI Atlas 33 (Moser, 1996). Any taxa that spawn in our study area and have been described with accompanying illustrations can be found within this website. Updated and new ELH data and figures will be added as information is published.

The complete list of larval fish taxa collected from Recruitment Processes Program cruises 1972 through 1996 used for initial consideration in the atlas (Matarese et al., 2003) is presented in Table 4 (Appendix C). This list was reduced to 102 taxa within 34 families (Table 5, Appendix C). All individual species covered in Matarese et al. (2003) are found in this website; taxa covered only at the genus or family level are not included. Additional maps will be added as distributional data are published.

Eggs -- Similar to the larvae as described above, most of the fish egg taxa included in the IIS can be found in our laboratory guide (Matarese et al., 1989), atlas (Matarese et al., 2003), or CalCOFI Atlas 33 (Moser, 1996). Of larval taxa in the IIS, any of their respective eggs that have been described can be found within this website; most/many have accompanying illustrations.

The complete list of fish egg taxa collected from Recruitment Processes Program cruises 1972 through 1996 used for initial consideration in the atlas is presented in Table 6 (Appendix C). Data were restricted to pelagic fish eggs due to sampling strategies and gear limitations. The selection process resulted in a total of 30 taxa included in 14 families (Table 7, Appendix C). For each taxon in the final list, distributional maps depicting presence/absence are presented in the IIS. As with larvae, additional egg distribution maps will be added as data are published.

General life history -- Life history data are provided as ancillary information, which may aid in identification of eggs and larvae. These data were extracted from the current general literature as well as original unpublished material. Geographic ranges are from RACEBASE, ICHBASE and current literature. Mecklenburg et al., 2002 provided a significant amount of new information. Range information is restricted to the study area. Thus, the limits of the southern distribution beyond the California-Mexican border (SSC = South of southern California), the northern range beyond the Arctic to the north and east, and the western range beyond the Bering Sea are not specified.

Format and Methods

Statistical Overview for Map Generation (for complete details, see Matarese et al., 2003)

The data described in the Information and Data Sources Section were combined to produce an average spatial distribution as presented in the maps on individual taxon pages. Abundance from each station was measured as catch per 10 m² surface area. The statistical method, which we adopted, was to stratify the data into equal-sized time intervals (e.g., years), which partially controls the bias due to uneven sampling effort in time. This does not completely correct the bias because some time interval strata have no data at all, and stratification does not help in these cases. Bias for the strata that do have data is corrected by giving each stratum equal weight regardless of the number of stations. For the maps, the data within each 625 km² grid cell were stratified by year. This removes bias due to uneven sampling between years within each cell, but only for those years for which each cell was sampled; this does not correct for uneven sampling for those years where the cell was not sampled at all.

Data Layers

The maps were produced with a geographic information system (GIS) using ArcInfo software (ArcInfo, 2008), a product of Environmental Systems Research Institute (ESRI). Generic base data such as land extents were derived from a combination of Global Land One-kilometer Base Elevation (GLOBE) (GLOBE Task Team, 1999) and Digital Chart of the World (DCW) data. To produce the land relief, GLOBE data were hill-shaded to show relief, missing data values were filled in, and data were clipped to the extent shown with the DCW data and converted to image format. Bathymetry data are from in-house and the General Bathymetric Chart of the Oceans digital atlas (GEBCO) (IOC, IHO, and BODC, 1997).

Occurrence Map Generation

Larval Occurrence Map

Fish density data (catch per 10 m²) were read into a GIS, i.e. ArcInfo, software and converted into ArcInfo coverages (data layers). The fish density data layer shows all the sample locations referenced geographically. However, samples were often taken at the same location resulting in points plotting on top of each other. Because we wanted to show the quantity and distribution of the samples, a different symbology was needed. Fish density is continuous in space even though the density may be zero at some locations. So, point locations were aggregated into a surface by overlaying the points onto a regular grid and assigning a mean value to each grid cell. The cell size of the grid is 25 km x 25 km (625 km²), or roughly 15.5 miles x 15.5 miles. The mean value at each grid cell was derived in two stages. First, the mean catch per 10 m² was calculated per cell per year, and then the mean catch per 10 m² was calculated per cell averaged over the years. This equalized the contribution of any single year since some years may have had a greater number of samples. The resulting data layer was a polygon showing all cells where samples were taken and their associated abundance based on catch per 10 m².

A chloropleth map design was chosen to depict abundance. The purpose of the map is to show the general spatial extent of the data and the general trend of average larval abundance

over space. Chloropleth maps shade statistical units with intensity proportional to the data values. All cells that were sampled, but contained no individuals of the taxon, are symbolized as gray, indicating absence. The remaining data were classified using quantiles: data were ranked, ordered, and divided into four categories, each containing an equal number of observations. The legend shows the range for each class and the colors are hierarchical in that lighter colors connote lower levels of abundance and darker colors connote higher levels.

Adult Occurrence Map

The occurrences of adults were derived for the most part from unpublished AFSC data residing in RACEBASE, an Oracle database. RACEBASE was developed by the Resource Assessment and Conservation Engineering Division (RACE) and comprises data from assessment, hydroacoustic, and foreign surveys conducted by federal fishery scientists from 1948 to the present. The geographic extent of RACEBASE data covers the continental shelf and slope of western North America and northeastern Asia from the Arctic Ocean (72° 14' N, 167° 52' W) south through the eastern half of the Chukchi Sea, throughout the Bering Sea (including the continental shelf of northeast Siberia), the Aleutian Basin and eastward along the Aleutian Islands, and along the U.S. Pacific coast from the Gulf of Alaska to the southern border of California (32° 28' N, 119° 18' W). Adult occurrence data points for taxa where standard RACEBASE data were insufficient were obtained from literature and unpublished sources. Maps generated with alternative data are identified with an asterisk in the legend and represent presence data only.

Egg Occurrence Map

The data for the egg occurrence map was processed similarly to the adult occurrence map. Data were extracted from ICHBASE and exported in ASCII text format. A data layer was created with the data using ArcInfo, which was then overlaid with a polygon grid having a 25 km x 25 km cell size to produce the final data layer showing presence or absence of eggs of the taxon. The result was a layout design consistent with the larval abundance map, which overcame the issue of stacked data points. Gray squares denote where samples were taken, but no eggs were found. Black squares show the presence of the taxon. Cell sizes appear smaller than those in the average larval abundance map because of the change in map scale.

Appendix A - Figures

Figure 1. Ichthyoplankton protocols and level of identification for sampling programs conducted by the Recruitment Processes Program, 1965-2005.

| Year | Sorting and Processing | Scientific Programs & Studies | Identification |
|------|--|---------------------------------------|--|
| 1965 | | | Pacific hake larvae |
| 1966 | | | |
| 1967 | BCF ¹ Biological Laboratory and At Sea | BCF Hake Studies | |
| 1968 | | | All larvae |
| 1969 | | | |
| 1970 | | | |
| 1971 | | | |
| 1972 | NWFC ² | MARMAP ⁴ | |
| 1973 | NWFC → NWAFC ³ | | |
| 1974 | | | All larvae and eggs |
| 1975 | | | |
| 1976 | | | |
| 1977 | Texas Instruments Corp. | OCSEAP ⁵ | |
| 1978 | | | |
| 1979 | | | |
| 1980 | | | All larvae ⁶ |
| 1981 | | | |
| 1982 | | NWAFC Studies USSR / USA Studies | |
| 1983 | | | |
| 1984 | | | |
| 1985 | | | |
| 1986 | | | |
| 1987 | | | |
| 1988 | Plankton Sorting and Identification Center, Szczecin, Poland | FOCI ⁷ | All larvae; walleye pollock egg identification and staging |
| 1989 | | | |
| 1990 | | | |
| 1991 | | NWAFC → AFSC ⁸ | |
| 1992 | | | |
| 1993 | | | |
| 1994 | | | |
| 1995 | | | |
| 1996 | | | |
| 1997 | | | |
| 1998 | | GLOBEC ⁹ | All larvae and eggs |
| 1999 | | | |
| 2000 | | | |
| 2001 | | | |
| 2002 | | SSL ¹⁰ | |
| 2003 | | | |
| 2004 | | | |
| 2005 | | EcoFOCI NPCREP ¹¹ | |

¹Bureau of Commercial Fisheries.

²Northwest Fisheries Center.

³Northwest and Alaska Fisheries Center.

⁴Marine Resources Monitoring, Assessment, and Prediction.

⁵Outer Continental Shelf Environmental Assessment Program.

⁶Eggs identified and larvae verified by Recruitment Processes Program.

⁷Fisheries-Oceanography Coordinated Investigations.

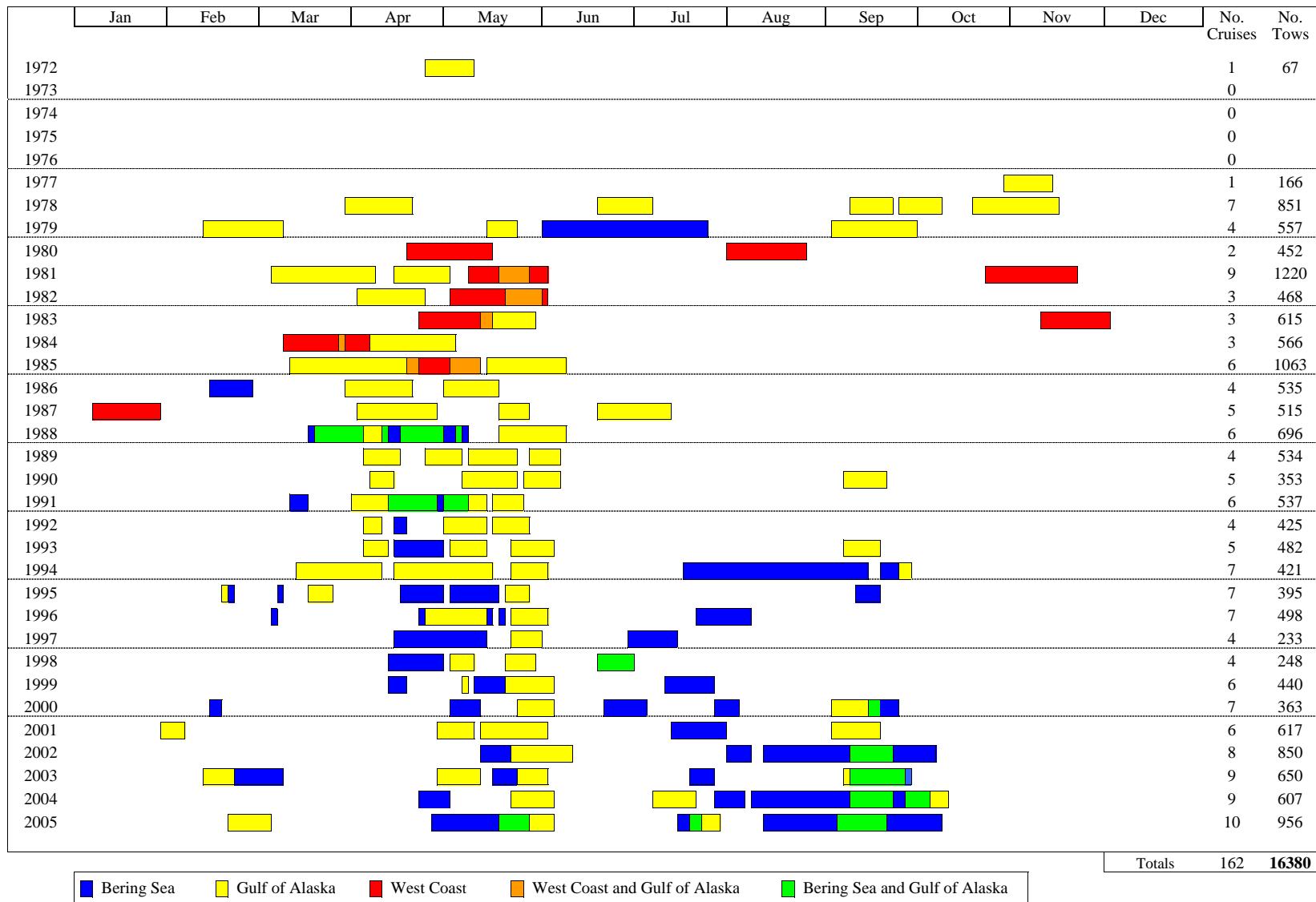
⁸Alaska Fisheries Science Center.

⁹Global Ocean Ecosystems Dynamics (1998-2003).

¹⁰Steller Sea Lion research (2002).

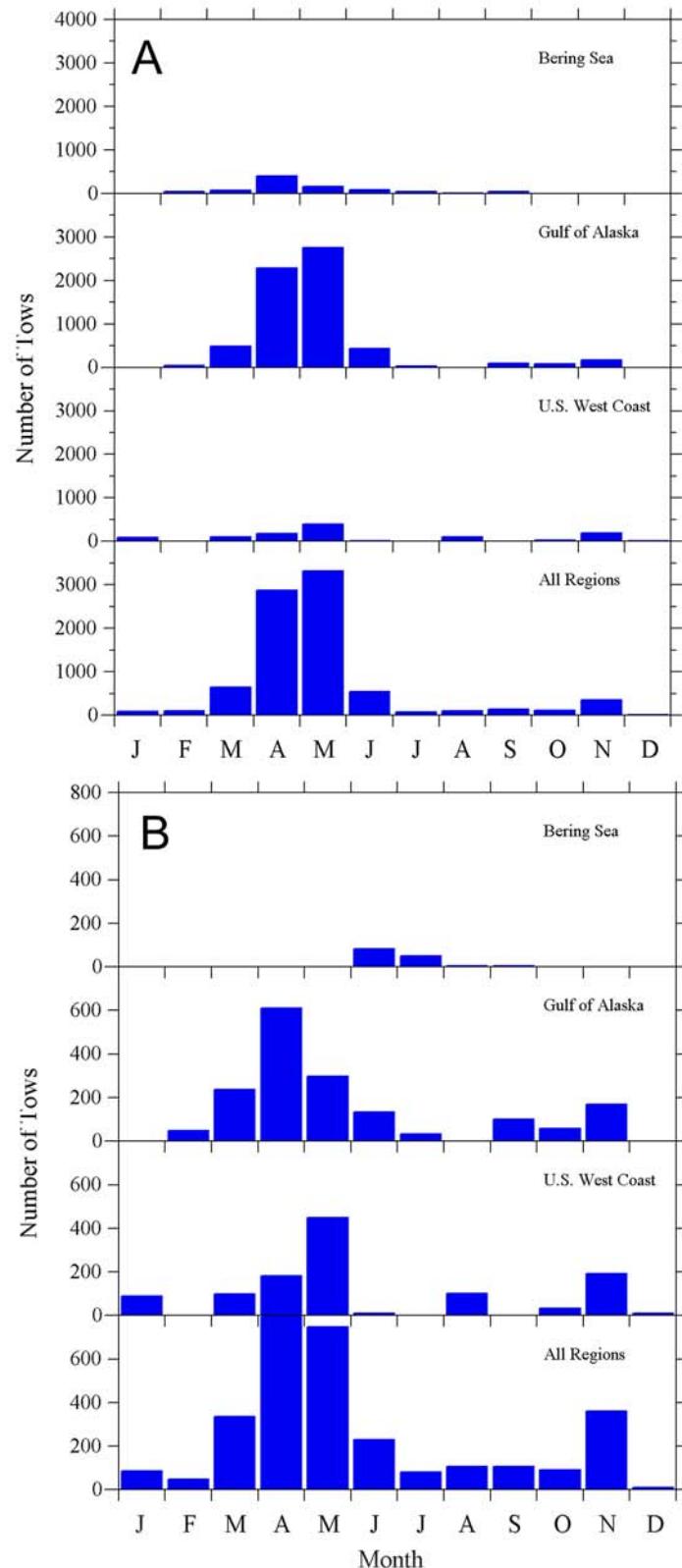
¹¹North Pacific Climate Regimes and Ecosystems Productivity.

Figure 2. Geographic and temporal coverage of Recruitment Processes Program ichthyoplankton survey data 1972-2005 available in larval fish database (ICHBASE).



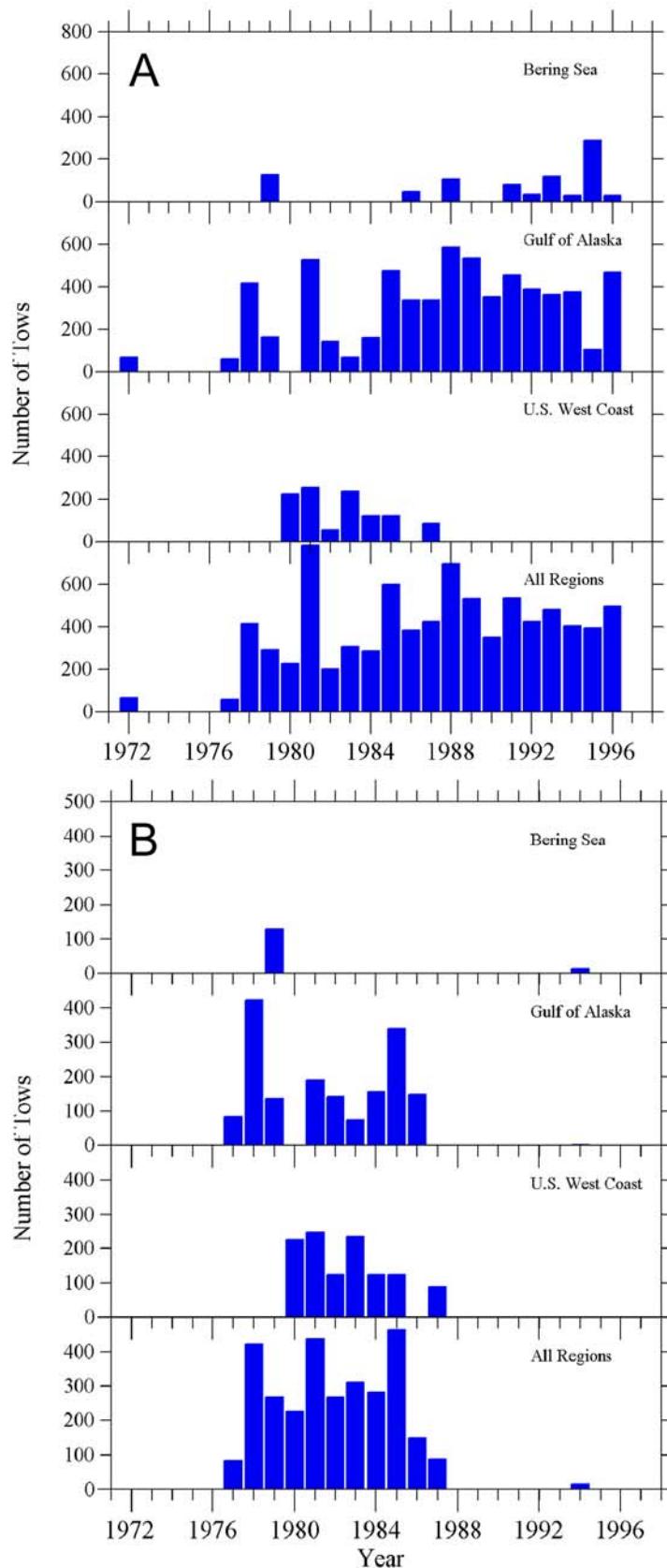
Appendix A - Figures

Figure 3. Monthly distribution and number of (A) combined bongo and Tucker tows (number of tows scaled to 4000) and (B) neuston tows (number of tows scaled to 800) by region.



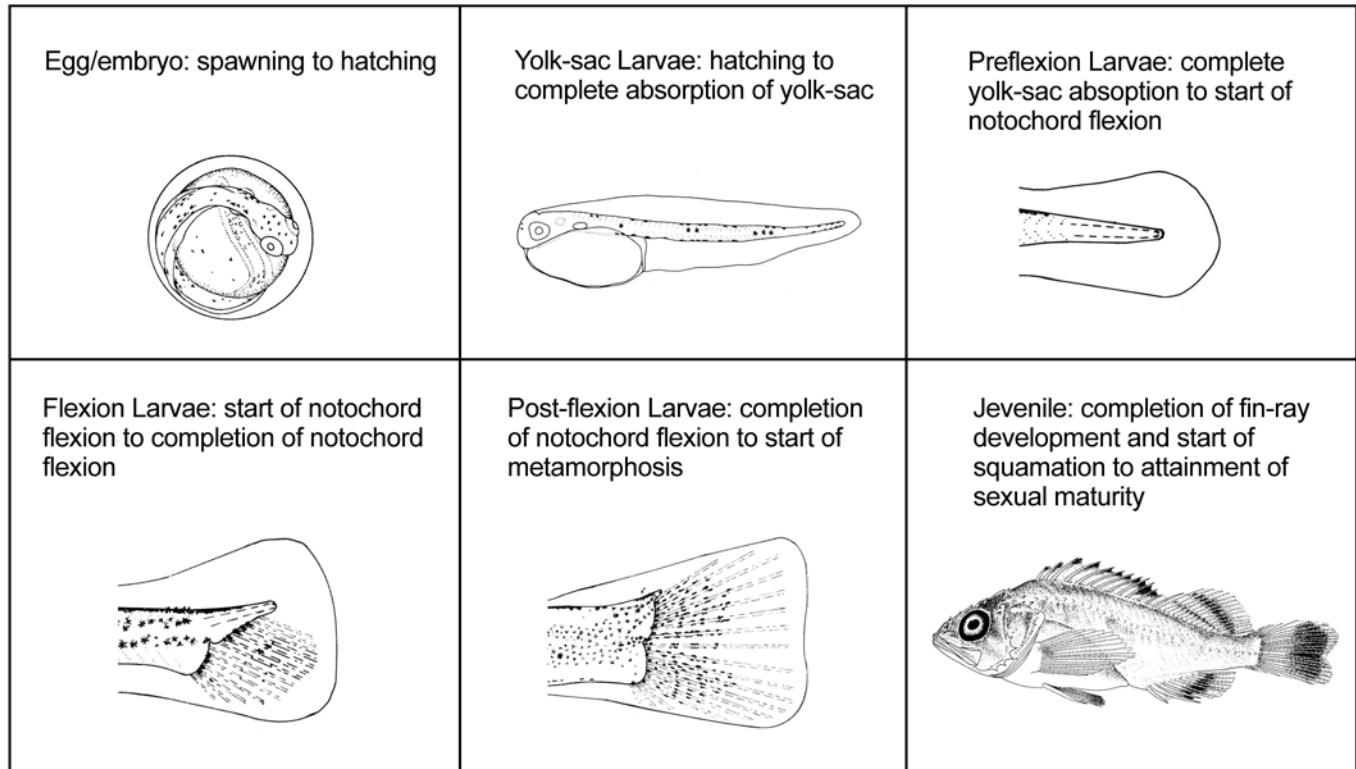
Appendix A - Figures

Figure 4. Yearly distribution and number of (A) combined bongo and Tucker tows (number of tows scaled to 800) and (B) neuston tows (number of tows scaled to 500) by region.



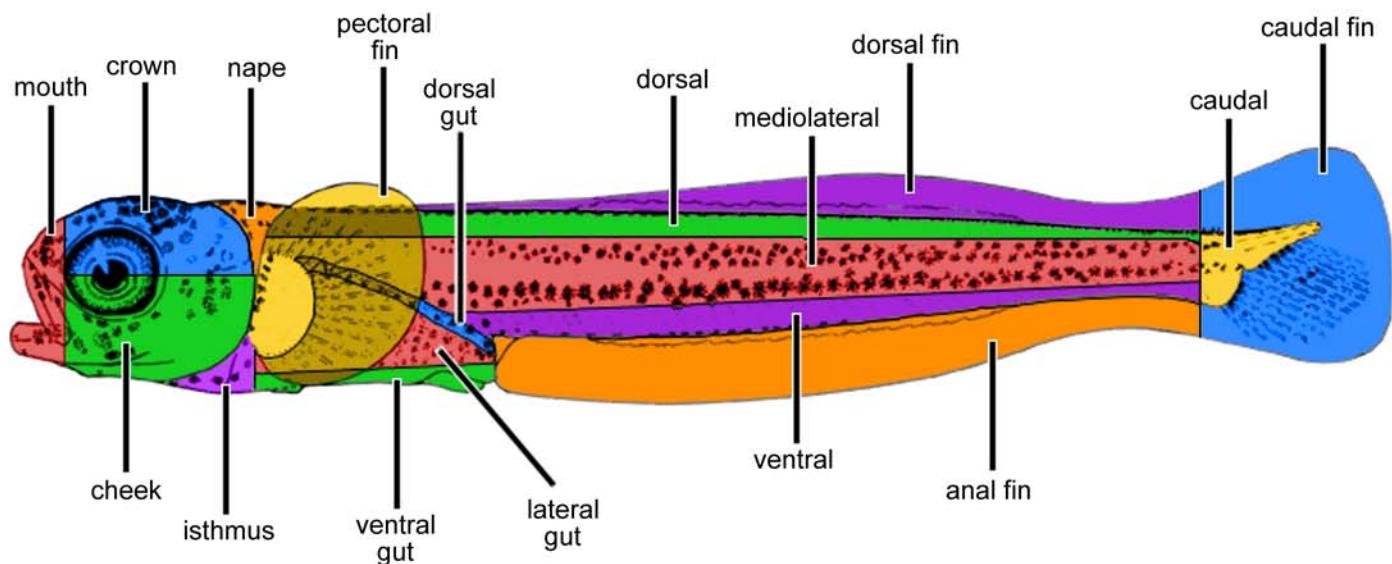
Appendix A - Figures

Figure 5. Illustration of developmental stages.



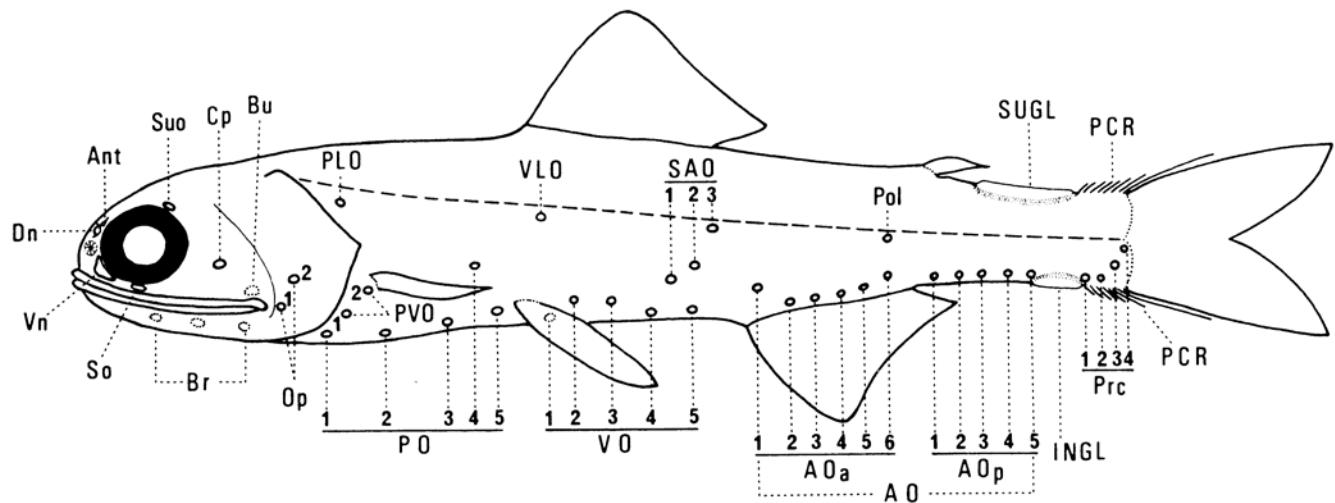
Appendix A - Figures

Figure 6. Pigmentation area definitions.



Appendix A - Figures

Figure 7. Generalized Myctophidae photophore pattern and terminology for Myctophidae (from Fujii 1984c). Ant—antorbital organ; AO—anal organs; AOa—anterior anal organs; AOp—posterior anal organs; Br—branchiostegal organs; Bu—buccal organ; Cp—cheek organ; Dn—dorsonasal organ; INGL—infracaudal luminous gland; Op—opercular organs; PLO—suprapectoral organ; PO—thoracic organs or pectoral organs; Pol—posterolateral organ; Prc—precaudal organs; PVO—subpectoral organs; SAO—supraanal organs; So—suborbital organ; SUGL—supracaudal luminous gland; Suo—supraorbital organ; VLO—supraventral organ; Vn—ventronasal organ; VO—ventral organs.



Appendix A - Figures

Figure 8. Generalized photophore patterns for gonostomatids (Fahay, 1983). For photophore definitions, see Table 9.

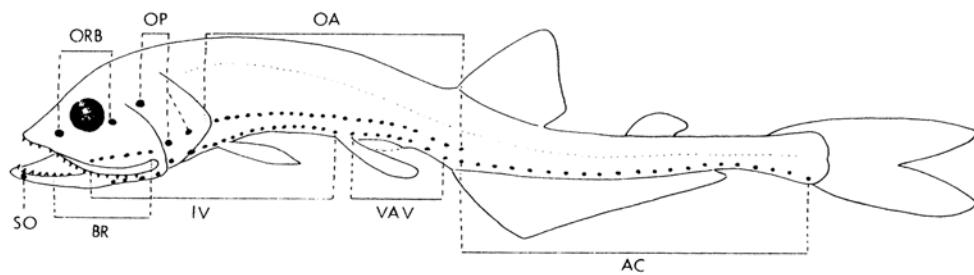
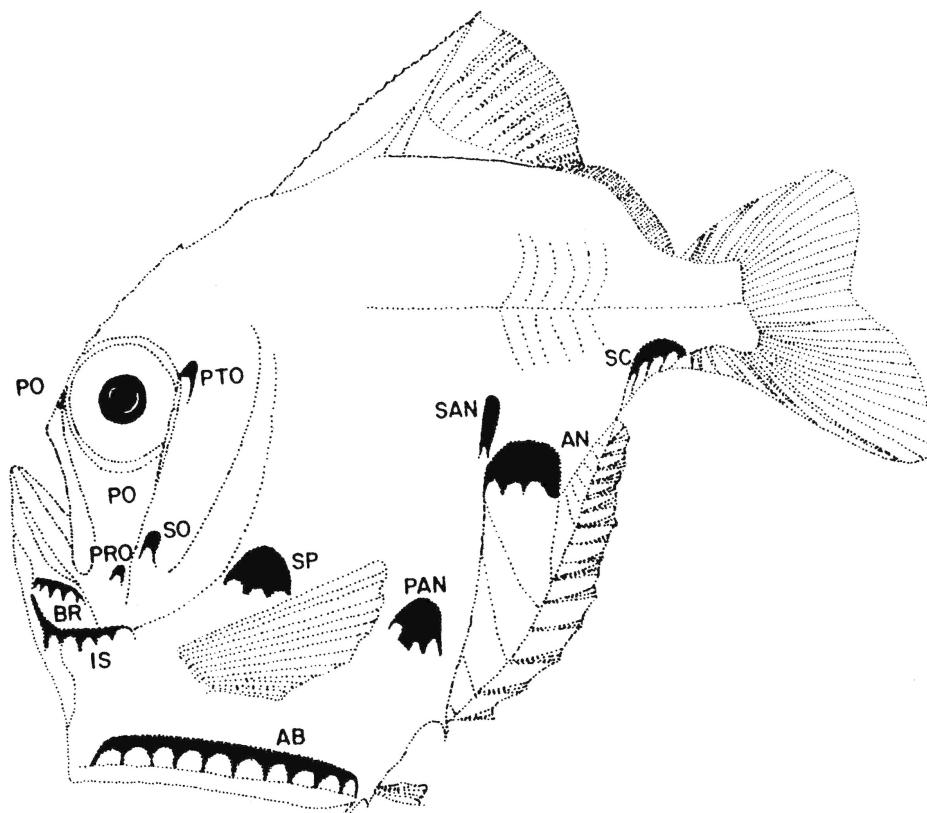
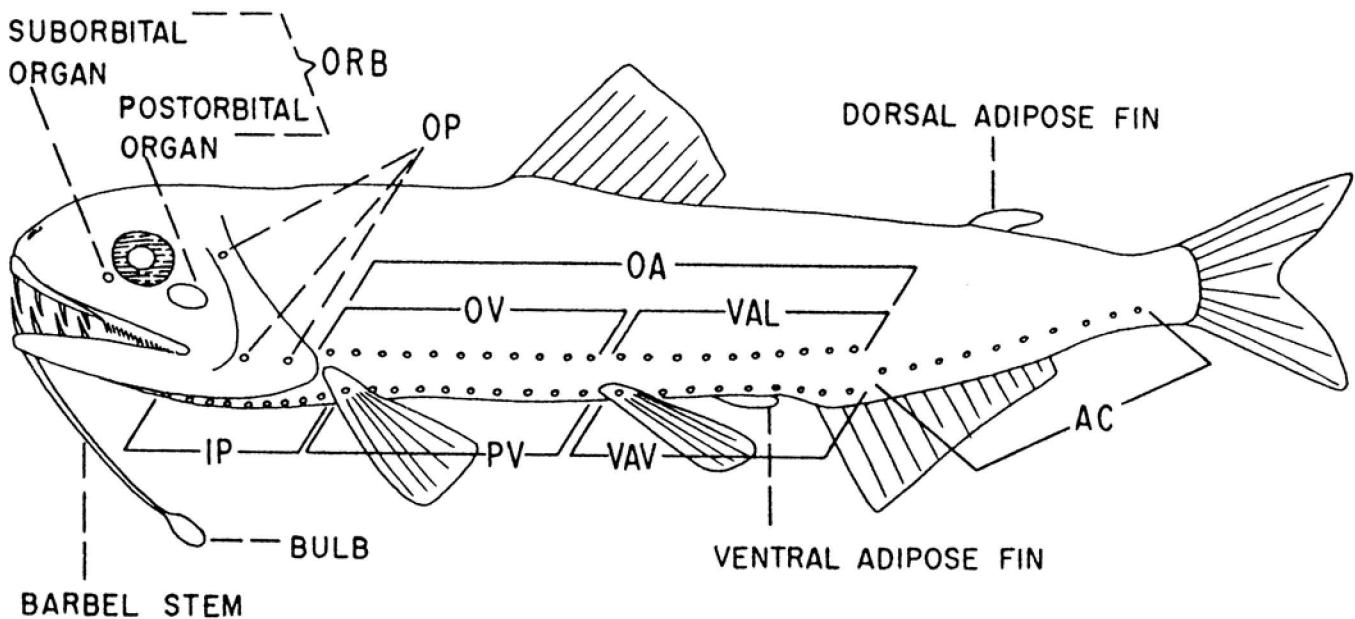


Figure 9. Generalized photophore patterns for sternoptychids (Moser and Watson, 1996; modified). For photophore definitions, see Table 9.



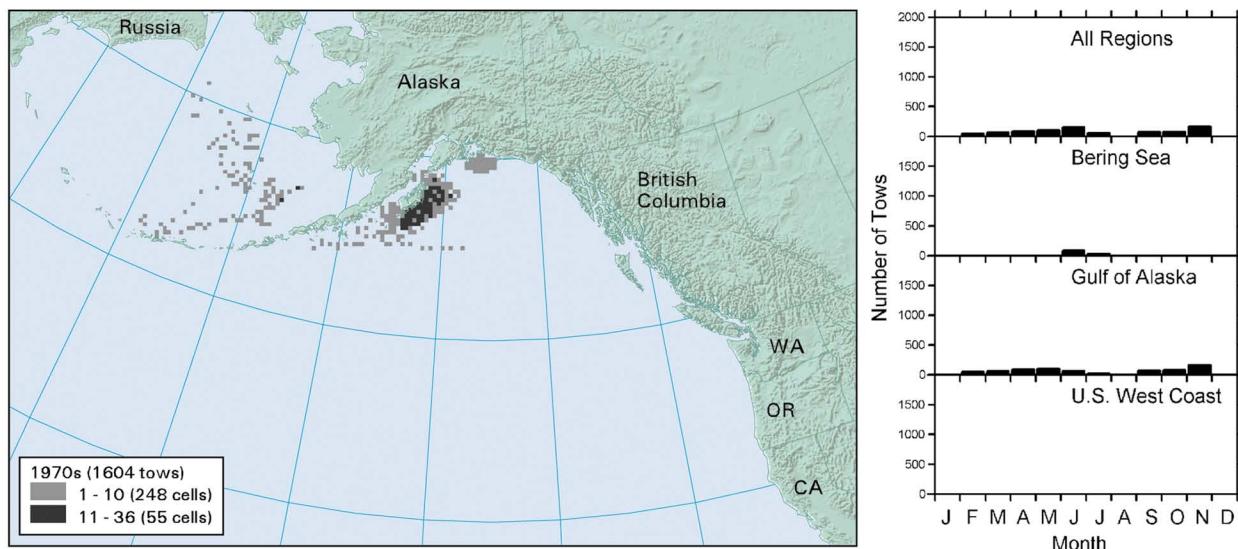
Appendix A - Figures

Figure 10. Generalized photophore patterns for stomioids (Morrow, 1964). For photophore definitions, see Table 9.



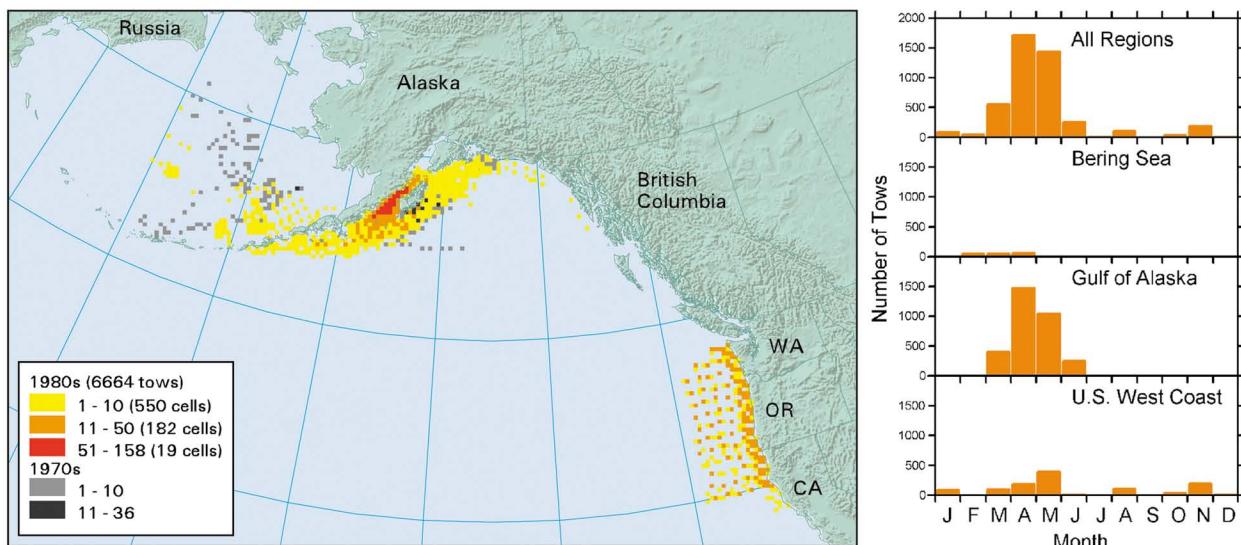
Appendix B - Maps

Map 1. Geographic distribution and sampling frequency of cruises conducted by the Recruitment Processes Program 1972-1979. Area sampled is divided into 625 km² cells. Gray cells were each sampled 1-10 times; black cells were each sampled 11-36 times. Graph at right shows monthly distribution and number of tows in the Bering Sea, Gulf of Alaska, and the two regions combined for the 1970s.



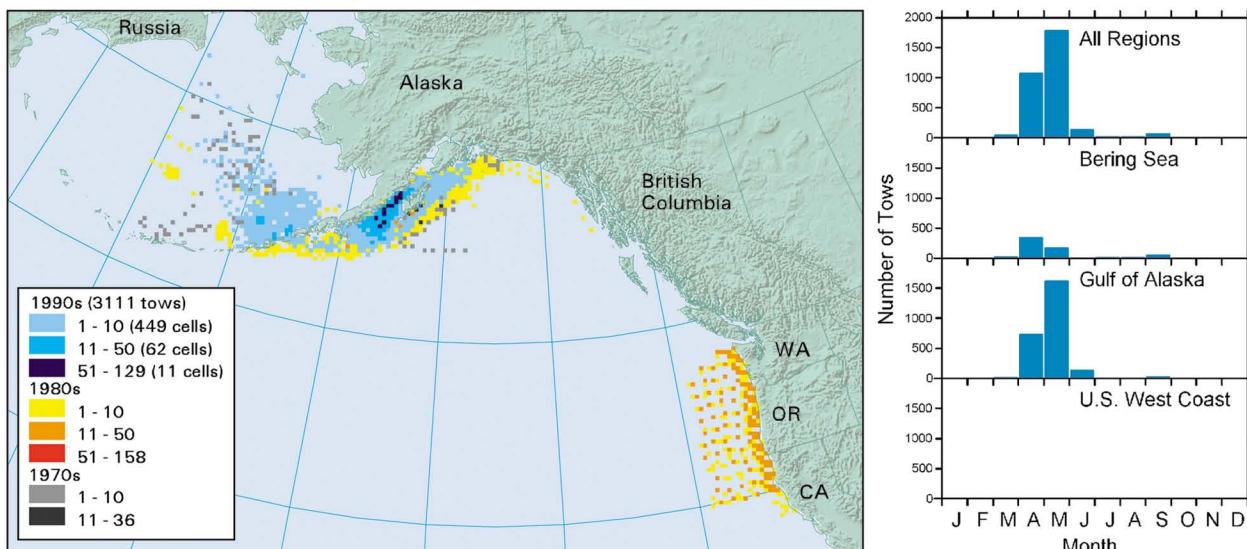
Appendix B - Maps

Map 2. Geographic distribution and sampling frequency of cruises conducted by Recruitment Processes Program 1972-1979 and 1980-1989. Area sampled is divided into 625 km² cells; 1970s data overlaid by 1980s data. For 1980s data, yellow cells were each sampled 1-10 times, orange cells were each sampled 11-50 times, and red cells were each sampled 51-158 times. Graph at right shows monthly distribution and number of tows in the Bering Sea, Gulf of Alaska, and off the U.S. West Coast, and the three regions combined for the 1980s.



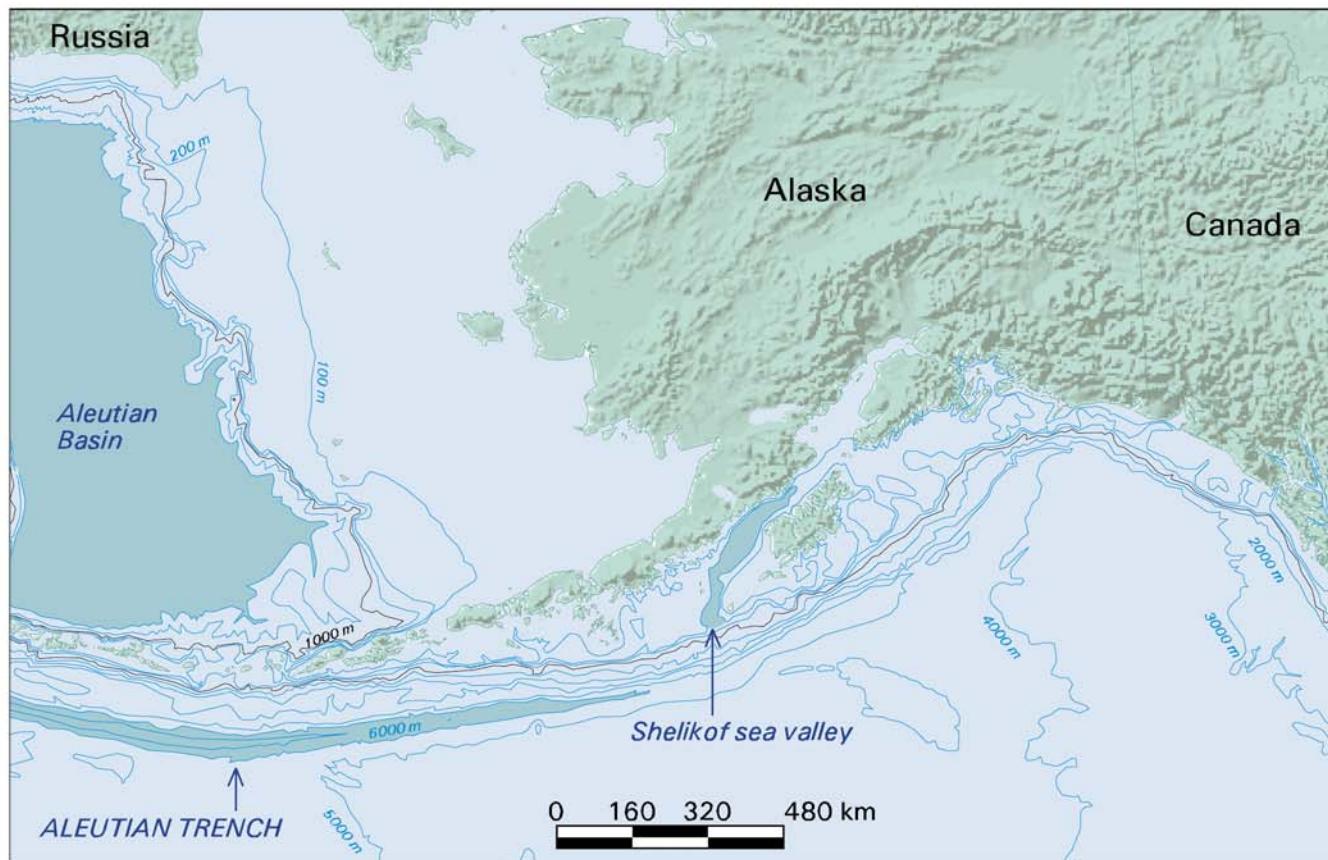
Appendix B - Maps

Map 3. Geographic distribution and sampling frequency of cruises conducted by Recruitment Processes Program 1972-1979, 1980-1989, and 1990-1996. Area sampled is divided into 625 km² cells; 1970s and 1980s data overlaid by 1990s data. For 1990s data, light blue cells were each sampled 1-10 times, medium blue cells were each sampled 11-50 times, and dark blue cells were each sampled 51-129 times. Graph at right shows monthly distribution and number of tows in the Bering Sea, Gulf of Alaska, and the two regions combined for the 1990s.



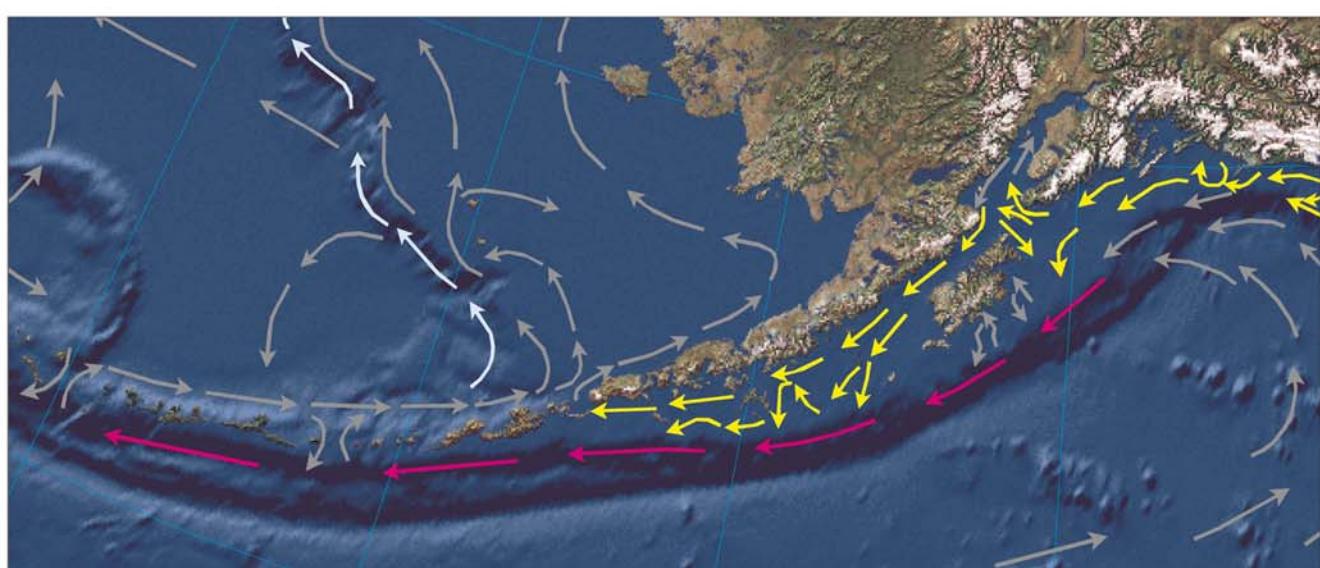
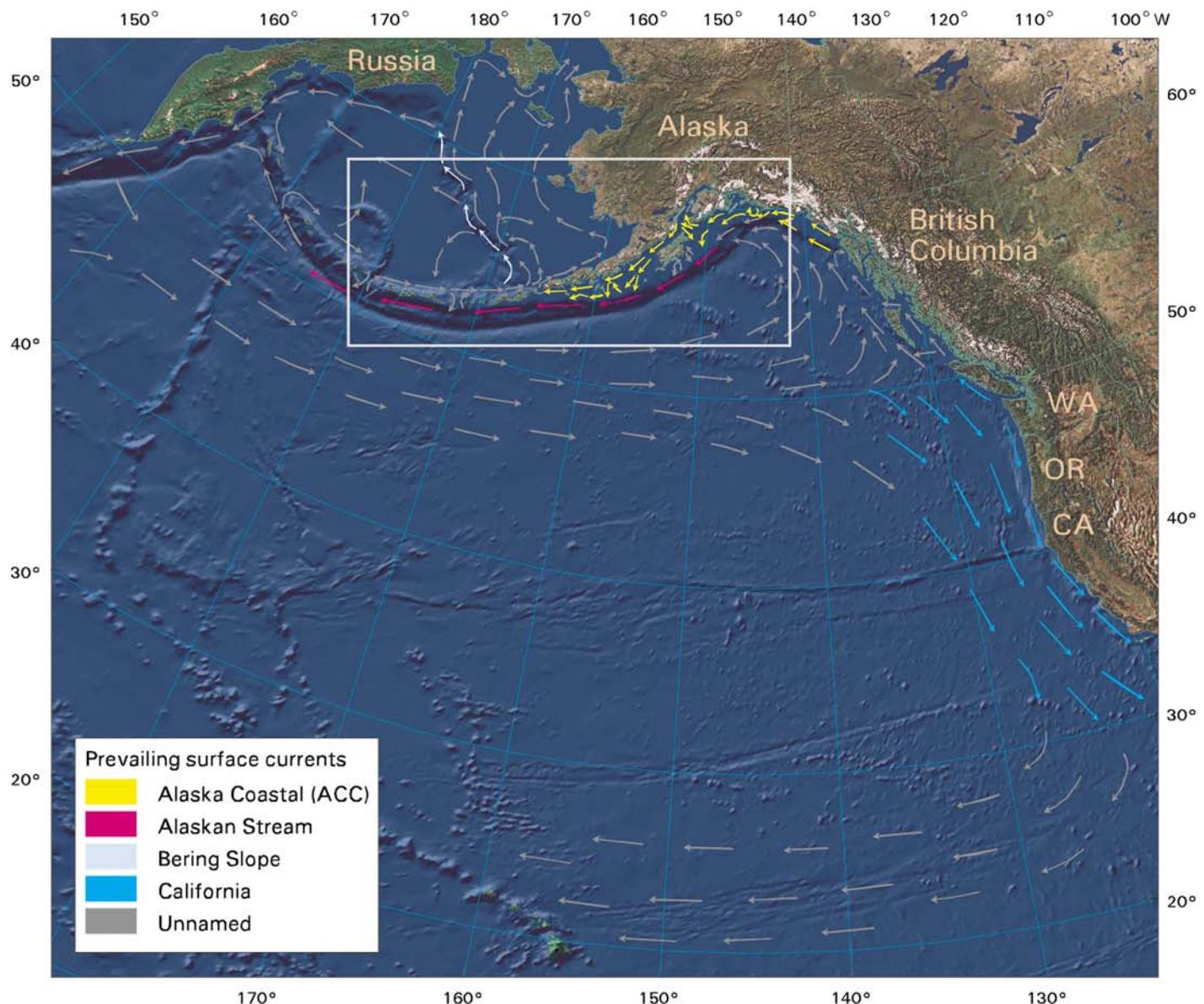
Appendix B - Maps

Map 4. Bathymetry of the eastern Bering Sea and Gulf of Alaska. Aleutian Basin, Aleutian Trench and Shelikof sea valley are shaded; 1000 m bathymetry contour line is black.



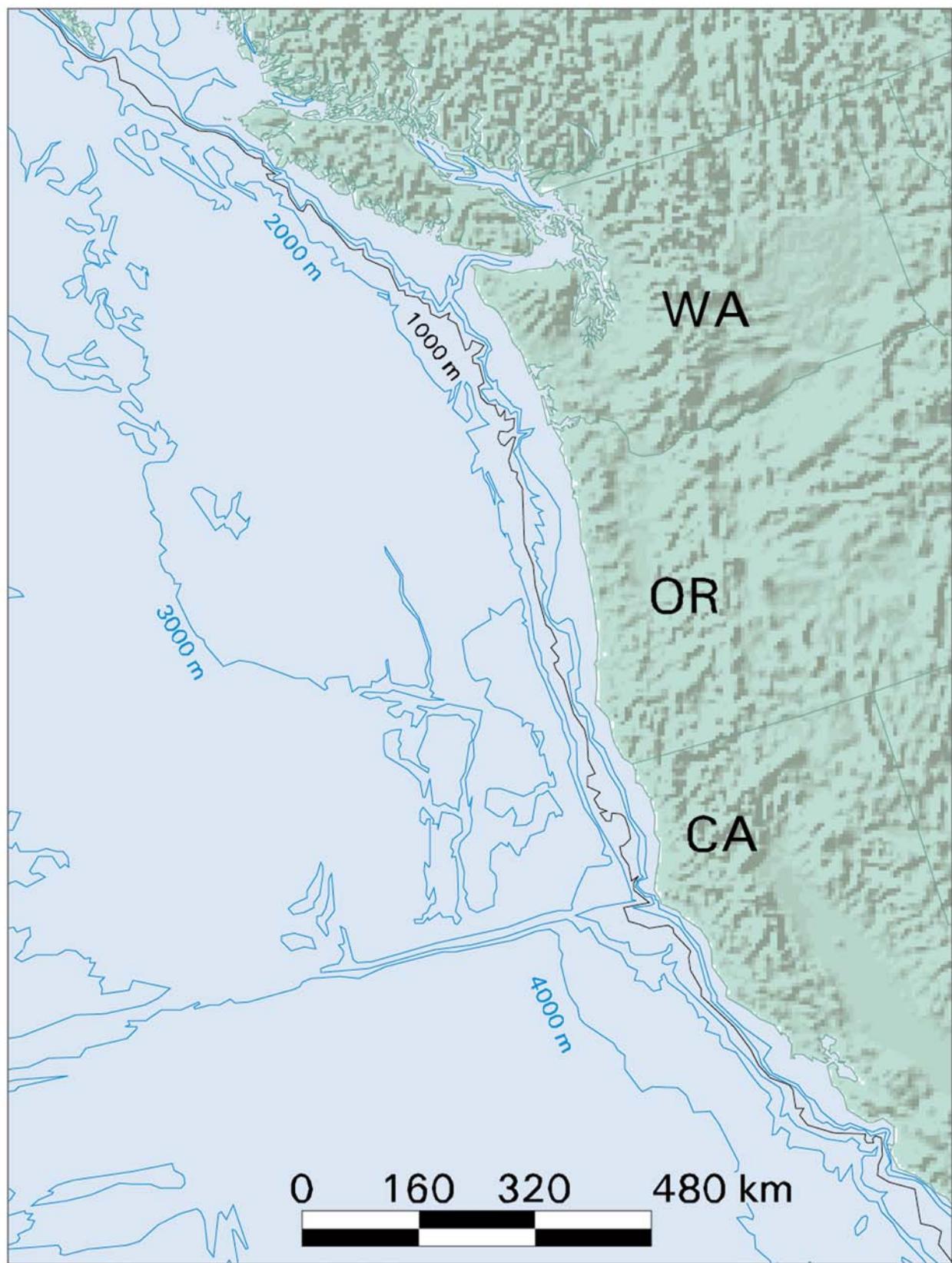
Appendix B - Maps

Map 5. Prevailing surface currents in the Bering Sea, Gulf of Alaska, and eastern North Pacific Ocean. Inset shows enlargement of surface currents in Alaskan waters.



Appendix B - Maps

Map 6. Bathymetry of the North Pacific Ocean off the U.S. west coast.



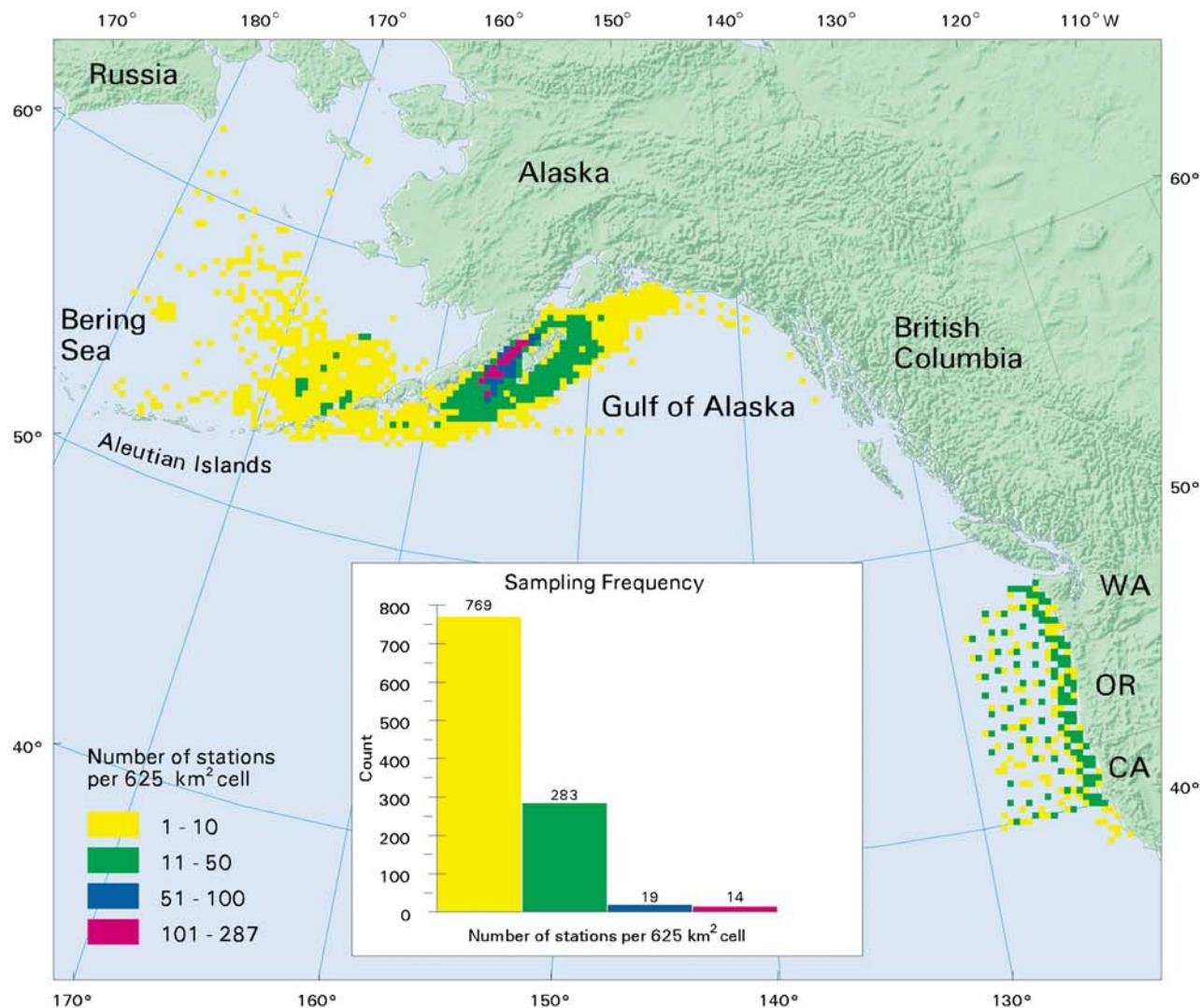
Appendix B - Maps

Map 7. Study area showing geographic features for Alaska (top map) and U.S. west coast (bottom map).



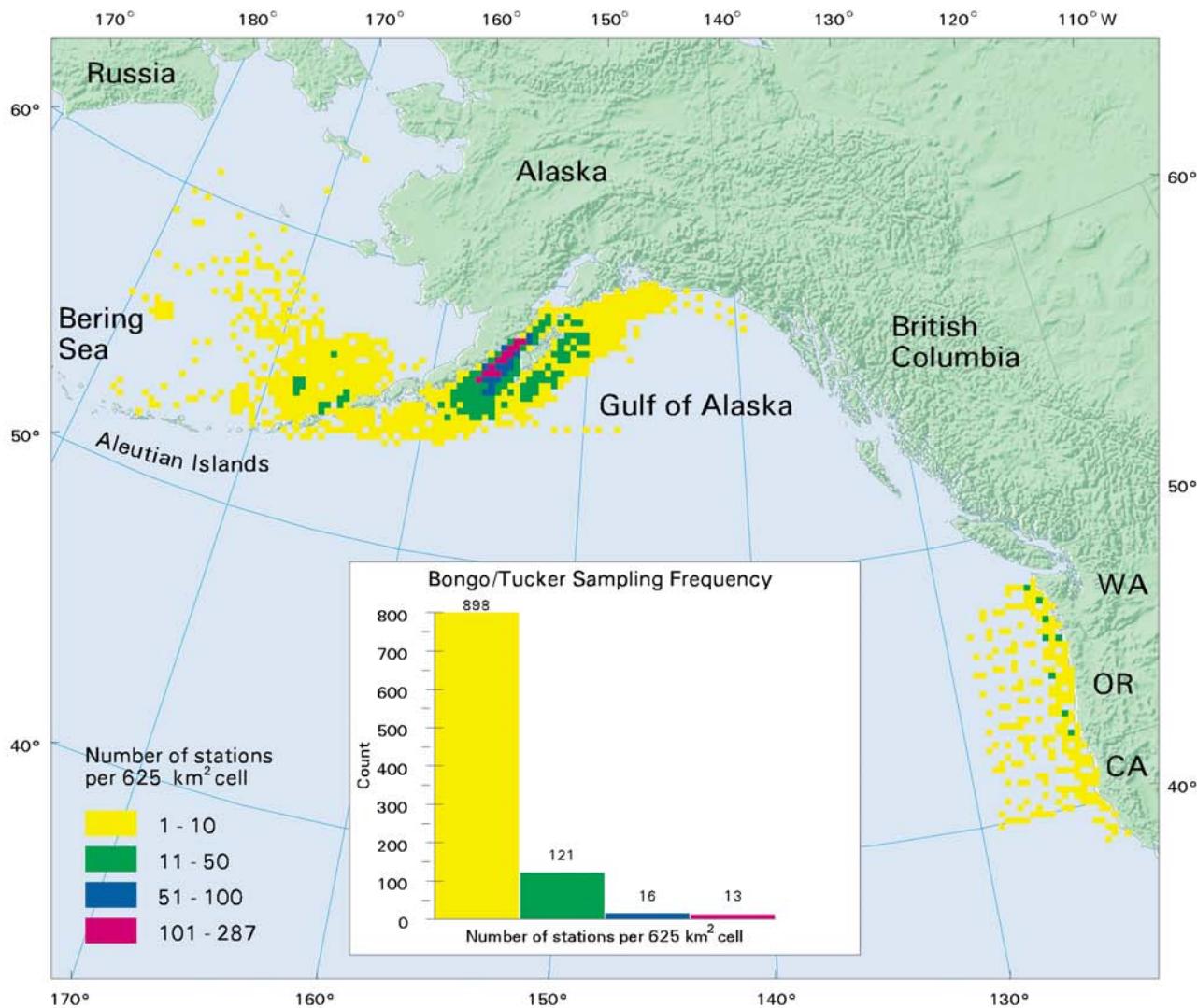
Appendix B - Maps

Map 8. Geographic distribution and frequency of sampling during Recruitment Processes Program ichthyoplankton surveys for 1972-1996. Area sampled is divided into 625 km² cells. Numbers over bars in histogram equal number of cells that contain 1-10 stations (yellow), 11-50 stations (green), 51-100 stations (blue), and 101-287 stations (red).



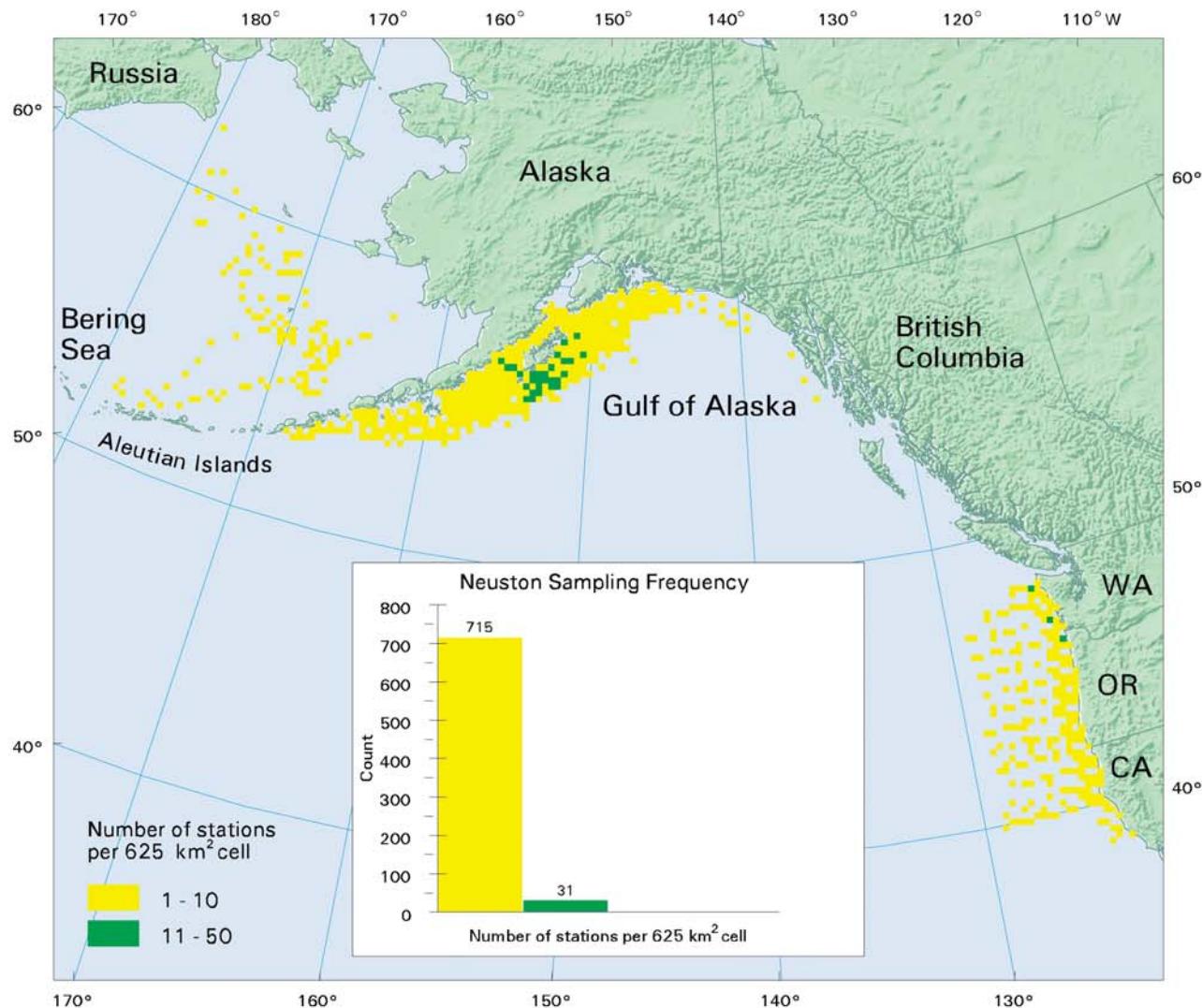
Appendix B - Maps

Map 9. Geographic distribution and frequency of sampling with bongo/Tucker gear during Recruitment Processes Program ichthyoplankton surveys for 1972-1996. Area sampled is divided into 623 km² cells. Numbers over bars in histogram equal number of cells that contain 1-10 stations (yellow), 11-50 stations (green), 51-100 stations (blue), and 101-287 stations (green).



Appendix B - Maps

Map 10. Geographic distribution and frequency of sampling with neuston gear during Recruitment Processes Program ichthyoplankton surveys for 1972-1996. Area sampled is divided into 625 km² cells. Numbers over bars in histogram equal number of cells that contain 1-10 stations (yellow) and 11-50 stations (green).



Appendix C - Tables

Table 1

Summary of Recruitment Processes Task ichthyoplankton surveys (1972-2005) with positive tows for larvae used in this study. BS = Bering Sea, GOA = Gulf of Alaska, WC = U. S. west coast. Bongo = bongo net, neuston = neuston net, Tucker = Tucker trawl. ICHBASE data not available for years 1973-1976.

| Year | Cruise | Area | Dates | Tows | Gear |
|-------------|---------------|-------------|---------------|-------------|-------------------|
| 1972 | 2KE72 | GOA | 4/26 - 5/9 | 67 | bongo |
| 1973 | | | | | |
| 1974 | | | | | |
| 1975 | | | | | |
| 1976 | | | | | |
| 1977 | 4MF77 | GOA | 10/30 - 11/14 | 83 83 | Tucker neuston |
| 1978 | 4DI78 | GOA | 3/29 - 4/20 | 85 113 | bongo neuston |
| | 2MF78 | GOA | 6/20 - 7/5 | 102 112 | Tucker neuston |
| | 3MF78 | GOA | 9/9 - 9/21 | 26 28 | bongo neuston |
| | 4MF78 | GOA | 9/26 - 10/7 | 66 45 | bongo neuston |
| | 5MF78 | GOA | 10/19 - 11/1 | 19 11 | bongo neuston |
| | 1WE78 | GOA | 10/27 - 11/13 | 88 92 | bongo neuston |
| | 6MF78 | GOA | 11/8 - 11/16 | 43 21 | bongo neuston |
| 1979 | 1MF79 | GOA | 2/14 - 3/8 | 88 89 | bongo neuston |
| | 5TK79 | GOA | 5/16 - 5/24 | 58 | bongo |
| | 3MF79 | BS | 6/1 - 7/23 | 126 130 | bongo neuston |
| | 1PO79 | GOA | 9/3 - 9/29 | 18 48 | bongo neuston |
| 1980 | 1TK80 | WC | 4/20 - 5/15 | 125 125 | bongo neuston |
| | 1PO80 | WC | 8/1 - 8/25 | 101 101 | bongo neuston |
| 1981 | 1SH81 | GOA | 3/5 - 3/30 | 131 | bongo |
| | 1MF81 | GOA | 3/5 - 3/27 | 130 | neuston |
| | 2MF81 | GOA | 3/12 - 3/20 | 31 | bongo |
| | 2SH81 | GOA | 3/30 - 4/8 | 89 | bongo |
| | 3MF81 | GOA | 4/16 - 4/24 | 60 60 | bongo neuston |
| | 1PO81 | WC | 4/26 - 5/2 | 79 | bongo |
| | 4MF81 | GOA | 5/9 - 6/2 | 131 123 | bongo neuston |
| | 3SH81 | GOA | 5/20 - 5/28 | 56 | bongo |
| | 1DA81 | WC | 10/24 - 11/21 | 125 | bongo |

Appendix C - Tables

Table 1

Summary of Recruitment Processes Task ichthyoplankton surveys (1972-2005) with positive tows for larvae used in this study. BS = Bering Sea, GOA = Gulf of Alaska, WC = U. S. west coast. Bongo = bongo net, neuston = neuston net, Tucker = Tucker trawl. ICHBASE data not available for years 1973-1976.

| Year | Cruise | Area | Dates | Tows | Gear |
|------|--------|------|--------------|------|---------|
| | | | | 125 | neuston |
| 1982 | 1DA82 | GOA | 4/4 - 4/23 | 83 | bongo |
| | | | | 82 | neuston |
| | 1PO82 | WC | 5/3 - 6/1 | 56 | bongo |
| | | | | 124 | neuston |
| | 2DA82 | GOA | 5/21 - 5/31 | 62 | bongo |
| | | | | 61 | neuston |
| 1983 | 1EQ83 | WC | 4/23 - 5/15 | 124 | bongo |
| | | | | 124 | neuston |
| | 1CH83 | GOA | 5/14 - 5/30 | 68 | bongo |
| | | | 5/14 - 5/28 | 73 | neuston |
| | 1MF83 | WC | 11/12 - 12/2 | 113 | bongo |
| | | | | 113 | neuston |
| 1984 | 1PO84 | WC | 3/11 - 4/5 | 124 | bongo |
| | | | | 124 | neuston |
| | 3CH84 | GOA | 3/28 | 4 | bongo |
| | 1SH84 | GOA | 4/7 - 5/4 | 157 | bongo |
| | | | | 157 | neuston |
| 1985 | 1DI85 | GOA | 3/11 - 3/28 | 69 | bongo |
| | 1PO85 | GOA | 3/29 - 4/21 | 154 | bongo |
| | | | | 151 | neuston |
| | 1MF85 | GOA | 4/9 | 1 | bongo |
| | 1BA85 | WC | 4/19 - 5/11 | 124 | bongo |
| | | | | 124 | neuston |
| | 2MF85 | GOA | 5/3 - 5/11 | 62 | bongo |
| | 2PO85 | GOA | 5/16 - 6/8 | 189 | bongo |
| | | | | 189 | neuston |
| 1986 | MF862 | BS | 2/16 - 2/28 | 48 | bongo |
| | 1GI86 | GOA | 3/30 - 4/20 | 149 | bongo |
| | | | | 149 | neuston |
| | 1MF86 | GOA | 4/4 - 4/12 | 81 | bongo |
| | 2MF86 | GOA | 5/2 - 5/18 | 108 | bongo |
| 1987 | 1MF87 | WC | 1/7 - 1/28 | 88 | bongo |
| | | | | 88 | neuston |
| | 2MF87 | GOA | 4/4 - 4/16 | 143 | bongo |
| | 1BB87 | GOA | 4/9 - 4/27 | 117 | bongo |
| | 3MF87 | GOA | 5/19 - 5/27 | 60 | bongo |
| | 4MF87 | GOA | 6/20 - 7/11 | 19 | bongo |
| 1988 | 1OC88 | BS | 3/17 - 4/4 | 61 | bongo |
| | 1DN88 | GOA | 3/19 - 4/11 | 157 | bongo |
| | 1MF88 | GOA | 4/1 - 4/12 | 173 | bongo |
| | 1DN88 | BS | 4/11 - 5/8 | 46 | bongo |
| | 2MF88 | GOA | 4/17 - 4/30 | 64 | bongo |
| | 3MF88 | GOA | 5/6 | 13 | bongo |
| | 4MF88 | GOA | 5/20 - 6/7 | 176 | Tucker |
| | | | 5/21 - 6/7 | 6 | bongo |

Appendix C - Tables

Table 1

Summary of Recruitment Processes Task ichthyoplankton surveys (1972-2005) with positive tows for larvae used in this study. BS = Bering Sea, GOA = Gulf of Alaska, WC = U. S. west coast. Bongo = bongo net, neuston = neuston net, Tucker = Tucker trawl. ICHBASE data not available for years 1973-1976.

| Year | Cruise | Area | Dates | Tows | Gear |
|-------------|---------------|-------------|--------------------|-------------|------------------|
| 1989 | 1MF89 | GOA | 4/6 - 4/15 | 128 | bongo |
| | 2MF89 | GOA | 4/26 - 5/5 | 92 | bongo |
| | 3MF89 | GOA | 5/9 - 5/24 | 211 | bongo |
| | 4MF89 | GOA | 5/29 - 6/5 6/3 | 99 4 | Tucker bongo |
| 1990 | 1MF90 | GOA | 4/8 - 4/13 | 107 | bongo |
| | 2MF90 | GOA | 5/7 - 5/15 | 90 | bongo |
| | 3MF90 | GOA | 5/18 - 5/24 | 17 | bongo |
| | 4MF90 | GOA | 5/28 - 6/5 | 133 | bongo |
| | 5MF90 | GOA | 9/8 - 9/20 | 6 | bongo |
| 1991 | 0MF91 | BS | 3/11 - 3/15 | 20 | bongo |
| | 1MF91 | GOA | 4/2 - 4/13 | 90 | bongo |
| | 1MP91 | BS | 4/14 - 5/8 | 61 | bongo |
| | 2MF91 | GOA | 4/16 - 4/27 | 150 | bongo |
| | 3MF91 | GOA | 5/1 - 5/13 | 119 | bongo |
| | 4MF91 | GOA | 5/17 - 5/25 | 97 | bongo |
| 1992 | 1MF92 | GOA | 4/5 - 4/10 | 94 | bongo |
| | 2MF92 | BS | 4/16 - 4/18 | 36 | bongo |
| | 3MF92 | GOA | 5/2 - 5/14 | 158 | bongo |
| | 4MF92 | GOA | 5/18 - 5/28 | 137 | bongo |
| 1993 | 2MF93 | GOA | 4/6 - 4/11 | 96 | bongo |
| | 3MF93 | BS | 4/15 - 4/30 | 119 | bongo |
| | 4MF93 | GOA | 5/3 - 5/13 | 141 | bongo |
| | 5MF93 | GOA | 5/23 - 6/3 | 114 | bongo |
| | 6MF93 | GOA | 9/7 - 9/17 | 12 | Tucker |
| 1994 | 3MF94 | GOA | 3/14 - 4/9 | 19 | bongo |
| | 4MF94 | GOA | 4/15 - 4/30 | 128 | bongo |
| | 5MF94 | GOA | 5/2 - 5/15 | 89 | bongo |
| | 6MF94 | GOA | 5/24 - 6/1 | 139 | bongo |
| | 7MF94 | BS | 7/17 - 9/6 | 10 | neuston |
| | 1SU94 | BS | 9/4 - 9/13 9/12 | 30 2 | bongo neuston |
| | 8MF94 | BS | 9/21 - 9/24 | 2 | neuston |
| | | GOA | 9/25 - 9/28 | 2 | neuston |
| 1995 | 1MF95 | BS | 2/19 | 1 | bongo |
| | 1MF95 | BS | 2/22 | 2 | bongo |
| | 2MF95 | BS | 3/8 | 1 | bongo |
| | 4MF95 | GOA | 3/17 - 3/24 | 5 | bongo |
| | 6MF95 | BS | 4/17 - 4/30 | 137 | bongo |
| | 7MF95 | BS | 5/4 - 5/18 | 134 | bongo |
| | 8MF95 | GOA | 5/21 - 5/28 | 99 | bongo |
| | 2SU95 | BS | 9/11 - 9/18 | 16 | Tucker |
| 1996 | 2MF96 | BS | 3/6 | 1 | bongo |
| | 5MF96 | BS | 4/23 - 4/24 | 4 | Tucker |
| | 1DI96 | GOA | 4/26 - 5/6 | 154 | bongo |

Appendix C - Tables

Table 1

Summary of Recruitment Processes Task ichthyoplankton surveys (1972-2005) with positive tows for larvae used in this study. BS = Bering Sea, GOA = Gulf of Alaska, WC = U. S. west coast. Bongo = bongo net, neuston = neuston net, Tucker = Tucker trawl. ICHBASE data not available for years 1973-1976.

| Year | Cruise | Area | Dates | Tows | Gear |
|-------------|---------------|-------------|--------------|-------------|-------------|
| | 6MF96 | GOA | 5/2 - 5/14 | 183 | bongo |
| | | BS | 5/15 | 5 | bongo |
| | 7MF96 | BS | 5/19 - 5/20 | 5 | Tucker |
| | 8MF96 | GOA | 5/24 - 6/1 | 130 | bongo |
| | 9MF96 | BS | 7/21 - 8/7 | 16 | bongo |
| 1997 | 5MF97 | BS | 4/15 - 5/1 | 34 | bongo |
| | 6MF97 | BS | 5/4 - 5/13 | 32 | bongo |
| | 8MF97 | GOA | 5/23 - 5/31 | 100 | bongo |
| | 4WE97 | BS | 6/29 - 7/14 | 67 | bongo |
| 1998 | 2MF98 | BS | 4/14 - 4/29 | 20 | bongo |
| | 4MF98 | GOA | 5/3 - 5/10 | 72 | bongo |
| | 5MF98 | GOA | 5/22 - 5/30 | 130 | bongo |
| | 3WE98 | GOA | 6/19 - 6/30 | 26 | bongo |
| 1999 | 1MF99 | BS | 4/14 - 4/18 | 37 | bongo |
| | 1WE99 | GOA | 5/7 - 5/8 | 6 | bongo |
| | 4MF99 | BS | 5/12 - 5/20 | 21 | bongo |
| | 5MF99 | GOA | 5/21 - 6/2 | 114 | bongo |
| | 2WE99 | GOA | 5/24 - 6/5 | 202 | bongo |
| | 1GP99 | BS | 7/12 - 7/26 | 60 | bongo |
| 2000 | 2MF00 | BS | 2/16 - 2/17 | 7 | bongo |
| | 5MF00 | BS | 5/3 - 5/11 | 67 | bongo |
| | 6MF00 | GOA | 5/26 - 6/4 | 142 | bongo |
| | 7MF00 | BS | 6/21 - 7/3 | 14 | bongo |
| | 1OM00 | BS | 7/28 - 7/31 | 8 | bongo |
| | 8MF00 | GOA | 9/3 - 9/18 | 109 | Tucker |
| | 1RB00 | BS | 9/16 - 9/23 | 16 | bongo |
| 2001 | 1MF01 | GOA | 1/29 - 2/5 | 18 | bongo |
| | 2MF01 | GOA | 4/29 - 5/9 | 148 | bongo |
| | 1RB01 | GOA | 5/14 - 5/23 | 81 | bongo |
| | 3MF01 | GOA | 5/25 - 6/2 | 148 | bongo |
| | 1OM01 | BS | 7/14 - 7/29 | 9 | bongo |
| | 4MF01 | GOA | 9/3 - 9/18 | 173 | Tucker |
| | | | | 40 | neuston |
| 2002 | 3MF02 | BS | 5/13 - 5/21 | 80 | bongo |
| | | | | 80 | neuston |
| | 1EW02 | GOA | 5/27 - 6/9 | 124 | bongo |
| | 4MF02 | GOA | 5/24 - 6/1 | 137 | bongo |
| | 1OM02 | BS | 8/2 - 8/8 | 7 | bongo |
| | 1MA02 | BS | 8/14 - 8/28 | 5 | bongo |
| | 1SS02 | BS | 8/20 - 10/6 | 109 | bongo |
| | | | | 8 | neuston |
| | 1NW02 | BS | 9/8 - 10/6 | 42 | bongo |
| | 5MF02 | GOA | 9/10 - 9/21 | 122 | bongo |
| | | | | 136 | neuston |
| 2003 | 1MF03 | GOA | 2/13 - 2/22 | 66 | bongo |
| | | | | 26 | neuston |

Appendix C - Tables

Table 1

Summary of Recruitment Processes Task ichthyoplankton surveys (1972-2005) with positive tows for larvae used in this study. BS = Bering Sea, GOA = Gulf of Alaska, WC = U. S. west coast. Bongo = bongo net, neuston = neuston net, Tucker = Tucker trawl. ICHBASE data not available for years 1973-1976.

| Year | Cruise | Area | Dates | Tows | Gear |
|-------------|---------------|-------------|--------------|-------------|-------------|
| | 2MF03 | BS | 2/24 - 3/7 | 15 | bongo |
| | 2KM03 | GOA | 4/29 - 5/11 | 67 | bongo |
| | 4MF03 | BS | 5/17 - 5/24 | 120 | bongo |
| | | | | 58 | neuston |
| | 5MF03 | GOA | 5/25 - 6/2 | 115 | bongo |
| | | | | 4 | neuston |
| | 1OM03 | BS | 7/19 - 7/26 | 5 | bongo |
| | 7MF03 | GOA | 9/7 - 9/21 | 123 | Tucker |
| | 1SS03 | BS | 9/9 - 9/27 | 45 | bongo |
| | 3KM03 | GOA | 9/20 - 9/26 | 6 | bongo |
| | | | | | |
| 2004 | 3MF04 | BS | 4/24 - 5/2 | 13 | bongo |
| | 5MF04 | GOA | 5/23 - 6/3 | 190 | bongo |
| | 2HX04 | GOA | 7/8 - 7/19 | 60 | bongo |
| | 1OM04 | BS | 7/28 - 8/5 | 6 | bongo |
| | 1KR04 | BS | 8/10 - 8/22 | 36 | bongo |
| | 1SS04 | BS | 8/14 - 9/28 | 97 | bongo |
| | 7MF04 | GOA | 9/9 - 9/22 | 91 | bongo |
| | | | | 90 | neuston |
| | 8MF04 | BS | 9/24 - 10/4 | 11 | bongo |
| | 1EW04 | GOA | 9/28 - 10/9 | 13 | bongo |
| | | | | | |
| 2005 | 2MF05 | GOA | 2/21 - 3/4 | 118 | bongo |
| | | | | 51 | neuston |
| | 1TT05 | BS | 4/28 - 5/7 | 23 | bongo |
| | 5MF05 | BS | 5/9 - 5/20 | 94 | bongo |
| | | | | 74 | neuston |
| | 3TT05 | BS | 5/16 - 5/27 | 42 | bongo |
| | 6MF05 | GOA | 5/21 - 6/3 | 193 | bongo |
| | 1OM05 | BS | 7/15 - 7/21 | 9 | bongo |
| | 1FA05 | GOA | 7/19 - 7/28 | 47 | bongo |
| | 1SS05 | BS | 8/14 - 10/7 | 119 | bongo |
| | 7MF05 | GOA | 9/5 - 9/19 | 170 | Tucker |
| | 8MF05 | BS | 9/21 - 10/4 | 16 | bongo |
| | | | | | |
| Totals | | | | 16380 | |

Table 2

Ranked frequency of occurrence (FO) of the 20 most common larval fish taxa collected in neuston nets from Recruitment Processes Program survey cruises 1972-1996. Average catch (no./10m²) at positive hauls is included. Total number of Sameoto neuston tows = 3011 (Matarese et al., 2003).

| Taxon | No. Positive Hauls | % FO | Sum of Catch/10m ² | Avg. Catch/10m ² |
|------------------------------------|-----------------------|-------|----------------------------------|--------------------------------|
| <i>Hexagrammos decagrammus</i> | 1385 | 46.00 | 637.652 | 0.212 |
| <i>Hexagrammos stelleri</i> | 384 | 12.75 | 75.230 | 0.025 |
| <i>Anoplopoma fimbria</i> | 382 | 12.69 | 74.945 | 0.025 |
| <i>Cryptacanthodes aleutensis</i> | 341 | 11.33 | 142.190 | 0.047 |
| <i>Hemilepidotus</i> spp. | 341 | 11.33 | 267.906 | 0.089 |
| <i>Cololabis saira</i> | 325 | 10.79 | 24.615 | 0.008 |
| <i>Hemilepidotus hemilepidotus</i> | 322 | 10.69 | 99.288 | 0.033 |
| <i>Bathymaster</i> spp. | 306 | 10.16 | 830.176 | 0.276 |
| <i>Hexagrammos lagocephalus</i> | 266 | 8.83 | 152.912 | 0.051 |
| <i>Sebastes</i> spp. | 263 | 8.73 | 42.836 | 0.014 |
| <i>Ammodytes hexapterus</i> | 257 | 8.54 | 236.692 | 0.079 |
| <i>Hexagrammos octogrammus</i> | 238 | 7.90 | 56.265 | 0.019 |
| <i>Pleurogrammus monopterygius</i> | 212 | 7.04 | 109.330 | 0.036 |
| <i>Hemilepidotus spinosus</i> | 211 | 7.01 | 73.237 | 0.024 |
| <i>Scorpaenichthys marmoratus</i> | 177 | 5.88 | 13.273 | 0.004 |
| <i>Mallotus villosus</i> | 160 | 5.31 | 30.691 | 0.010 |
| <i>Hemilepidotus jordani</i> | 103 | 3.42 | 8.203 | 0.003 |
| <i>Hexagrammos</i> spp. | 102 | 3.39 | 15.344 | 0.005 |
| <i>Theragra chalcogramma</i> | 100 | 3.32 | 24.469 | 0.008 |
| Stichaeidae | 90 | 2.99 | 4.870 | 0.002 |

Table 3

Taxa abundance and distribution described by neuston data.

| Family | Taxon |
|-------------------|---|
| Scomberesocidae | <i>Cololabis saira</i> |
| Anoplopomatidae | <i>Anoplopoma fimbria</i> |
| Hexagrammidae | <i>Hexagrammos lagocephalus</i> <i>Hexagrammos octogrammus</i> <i>Hexagrammos stelleri</i> <i>Ophiodon elongatus</i> |
| Cottidae | <i>Hemilepidotus jordani</i> <i>Hemilepidotus spinosus</i> |
| Cryptacanthodidae | <i>Cryptacanthodes aleutensis</i> <i>Cryptacanthodes gigantea</i> |

Appendix C - Tables

Table 4

Ranked frequency of occurrence (FO) of larval fish taxa collected in bongo nets from Recruitment Processes Task survey cruises 1972-1996. Average catch (number per 10m²) at positive hauls is included. Total number of 60 cm bongo tows = 8368 (includes 312 Tucker trawls). Bolded taxa are covered in Matarese et al. (2003). Gray taxa are combined at a higher taxonomic level.

| Taxon | No. Positive Hauls | % FO | Sum of Catch/10m ² | Avg. Catch/10m ² |
|---|--------------------------|-------|----------------------------------|--------------------------------|
| <i>Theragra chalcogramma</i> | 4773 | 57.04 | 4984654.103 | 595.680 |
| <i>Ammodytes hexapterus</i> | 4542 | 54.28 | 358528.691 | 42.845 |
| <i>Stenobrachius leucopsarus</i> | 2581 | 30.84 | 111925.502 | 13.375 |
| <i>Lepidopsetta polyxystra</i> | 2093 | 25.01 | 72725.350 | 8.691 |
| <i>Hippoglossoides elassodon</i> | 1867 | 22.31 | 108951.468 | 13.020 |
| <i>Gadus macrocephalus</i> | 1823 | 21.79 | 98380.316 | 11.757 |
| <i>Bathymaster</i> spp. | 1457 | 17.41 | 151675.355 | 18.126 |
| <i>Sebastes</i> spp.¹ | 1309 | 15.64 | 59128.424 | 7.066 |
| <i>Hexagrammos decagrammus</i> | 1063 | 12.70 | 16103.647 | 1.924 |
| Gadidae | 1043 | 12.46 | 174694.365 | 20.876 |
| <i>Atheresthes stomias</i> | 932 | 11.14 | 40228.857 | 4.807 |
| <i>Icelinus</i> spp. | 774 | 9.25 | 13974.818 | 1.670 |
| Cyclopteridae | 718 | 8.58 | 8550.829 | 1.022 |
| <i>Leuroglossus schmidti</i> | 690 | 8.25 | 7606.181 | 0.909 |
| <i>Hippoglossus stenolepis</i> | 643 | 7.68 | 7203.780 | 0.861 |
| <i>Bathyagonus alascanus</i> | 583 | 6.97 | 4888.797 | 0.584 |
| <i>Bathylagus pacificus</i> | 523 | 6.25 | 5284.756 | 0.632 |
| <i>Lumpenus maculatus</i> | 481 | 5.75 | 4597.007 | 0.549 |
| Disintegrated | 475 | 5.68 | 7990.944 | 0.955 |
| <i>Mallotus villosus</i> | 475 | 5.68 | 11348.954 | 1.356 |
| <i>Cryptacanthodes aleutensis</i> | 453 | 5.41 | 3823.550 | 0.457 |
| <i>Platichthys stellatus</i> | 448 | 5.35 | 8004.080 | 0.957 |
| <i>Protomyctophum thompsoni</i> | 446 | 5.33 | 3850.982 | 0.460 |
| <i>Hemilepidotus hemilepidotus</i> | 433 | 5.17 | 4625.840 | 0.553 |
| Cottidae | 417 | 4.98 | 5315.520 | 0.635 |
| <i>Tarletonbeania crenularis</i> | 389 | 4.65 | 8875.654 | 1.061 |
| <i>Lepidopsetta bilineata</i> | 385 | 4.60 | 4424.407 | 0.529 |
| <i>Atheresthes</i> spp. | 382 | 4.57 | 9245.819 | 1.105 |
| <i>Lumpenus</i> spp. | 376 | 4.49 | 3302.633 | 0.395 |
| <i>Bathylagus ochotensis</i> | 373 | 4.46 | 14590.430 | 1.744 |
| <i>Anoplarchus</i> spp. | 330 | 3.94 | 6140.290 | 0.734 |
| <i>Hemilepidotus</i> spp. | 311 | 3.72 | 14138.913 | 1.690 |
| <i>Glyptocephalus zachirus</i> | 288 | 3.44 | 3328.929 | 0.398 |
| <i>Protomyctophum crockeri</i> | 274 | 3.27 | 3467.119 | 0.414 |
| <i>Poroclinus rothrocki</i> | 264 | 3.15 | 3224.067 | 0.385 |

Appendix C - Tables

Table 4

Ranked frequency of occurrence (FO) of larval fish taxa collected in bongo nets from Recruitment Processes Task survey cruises 1972-1996. Average catch (number per 10m²) at positive hauls is included. Total number of 60 cm bongo tows = 8368 (includes 312 Tucker trawls). Bolded taxa are covered in Matarese et al. (2003). Gray taxa are combined at a higher taxonomic level.

| Taxon | No. Positive Hauls | % FO | Sum of Catch/10m ² | Avg. Catch/10m ² |
|--|--------------------------|------|----------------------------------|--------------------------------|
| <i>Diaphus theta</i> | 256 | 3.06 | 21918.638 | 2.619 |
| Unidentified | 220 | 2.63 | 3384.227 | 0.404 |
| <i>Artediusharringtoni</i> | 210 | 2.51 | 1619.195 | 0.193 |
| <i>Zaprora silenus</i> | 196 | 2.34 | 1411.285 | 0.169 |
| <i>Reinhardtius hippoglossoides</i> | 192 | 2.29 | 2372.440 | 0.284 |
| <i>Lyopsetta exilis</i> | 184 | 2.20 | 3475.021 | 0.415 |
| <i>Pleuronectes quadrifasciatus</i> | 179 | 2.14 | 1408.827 | 0.168 |
| <i>Anoplopoma fimbria</i> | 176 | 2.10 | 1777.740 | 0.212 |
| <i>Radulinus asprellus</i> | 175 | 2.09 | 1269.537 | 0.152 |
| Osmeridae² | 173 | 2.07 | 44895.193 | 5.365 |
| <i>Lumpenus sagitta</i> | 164 | 1.96 | 1321.844 | 0.158 |
| <i>Chauliodus macouni</i> | 162 | 1.94 | 1365.560 | 0.163 |
| Agonidae | 125 | 1.49 | 987.317 | 0.118 |
| <i>Microstomus pacificus</i> | 125 | 1.49 | 1163.814 | 0.139 |
| Stichaeidae | 123 | 1.47 | 1197.698 | 0.143 |
| <i>Lumpenella longirostris</i> | 120 | 1.43 | 1660.305 | 0.198 |
| <i>Isopsetta isolepis</i> | 112 | 1.34 | 1774.415 | 0.212 |
| <i>Ruscarius meanyi</i> | 107 | 1.28 | 756.404 | 0.090 |
| Liparidae | 103 | 1.23 | 1169.191 | 0.140 |
| <i>Lestidiops ringens</i> | 102 | 1.22 | 1015.174 | 0.121 |
| <i>Pleurogrammus monopterygius</i> | 96 | 1.15 | 1109.763 | 0.133 |
| <i>Parophrys vetulus</i> | 88 | 1.05 | 2481.143 | 0.297 |
| <i>Sebastolobus</i> spp. | 88 | 1.05 | 1351.225 | 0.161 |
| <i>Lampanyctus ritteri</i> | 86 | 1.03 | 1049.816 | 0.125 |
| <i>Pholis</i> spp. | 83 | 0.99 | 1020.082 | 0.122 |
| <i>Myoxocephalus</i> B³ | 82 | 0.98 | 1172.842 | 0.140 |
| Bathylagidae | 80 | 0.96 | 1008.448 | 0.121 |
| <i>Bathyagonus infraspinatus</i> | 78 | 0.93 | 419.048 | 0.050 |
| <i>Hexagrammos lagocephalus</i> | 78 | 0.93 | 2435.621 | 0.291 |
| <i>Myoxocephalus</i> spp.³ | 78 | 0.93 | 588.522 | 0.070 |
| Macrouridae⁴ | 74 | 0.88 | 462.768 | 0.055 |
| <i>Citharichthys stigmaeus</i> | 73 | 0.87 | 638.370 | 0.076 |
| <i>Citharichthys sordidus</i> | 72 | 0.86 | 778.503 | 0.093 |
| <i>Nansenia candida</i> | 67 | 0.80 | 905.344 | 0.108 |

Appendix C - Tables

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Ranked frequency of occurrence (FO) of larval fish taxa collected in bongo nets from Recruitment Processes Task survey cruises 1972-1996. Average catch (number per 10m²) at positive hauls is included. Total number of 60 cm bongo tows = 8368 (includes 312 Tucker trawls). Bolded taxa are covered in Matarese et al. (2003). Gray taxa are combined at a higher taxonomic level.

| Taxon | No. Positive Hauls | % FO | Sum of Catch/10m ² | Avg. Catch/10m ² |
|--|--------------------------|------|----------------------------------|--------------------------------|
| <i>Liparis</i> spp⁵ | 66 | 0.79 | 903.933 | 0.108 |
| <i>Myoxocephalus</i> G ³ | 63 | 0.75 | 529.201 | 0.063 |
| <i>Engraulis mordax</i> | 61 | 0.73 | 13876.181 | 1.658 |
| <i>Hexagrammos stelleri</i> | 59 | 0.71 | 524.865 | 0.063 |
| Myctophidae | 59 | 0.71 | 1800.924 | 0.215 |
| <i>Psettichthys melanostictus</i> | 59 | 0.71 | 728.765 | 0.087 |
| <i>Gymnophanrus</i> A | 58 | 0.69 | 416.647 | 0.050 |
| <i>Hemilepidotus spinosus</i> | 57 | 0.68 | 493.171 | 0.059 |
| <i>Lampanyctus</i> spp. | 57 | 0.68 | 841.834 | 0.101 |
| Melamphaeidae⁶ | 53 | 0.63 | 526.923 | 0.063 |
| <i>Ophiodon elongatus</i> | 53 | 0.63 | 316.392 | 0.038 |
| <i>Ronquilus jordani</i> | 53 | 0.63 | 546.780 | 0.065 |
| <i>Stenobrachius</i> spp. | 52 | 0.62 | 877.596 | 0.105 |
| <i>Bryozoichthys lysimus</i> | 51 | 0.61 | 325.180 | 0.039 |
| <i>Podothecus acipenserinus</i> | 51 | 0.61 | 394.838 | 0.047 |
| Pleuronectidae | 49 | 0.59 | 493.858 | 0.059 |
| <i>Malacocottus zonurus</i> 1 | 48 | 0.57 | 314.704 | 0.038 |
| <i>Icichthys lockingtoni</i> | 47 | 0.56 | 423.619 | 0.051 |
| <i>Citharichthys</i> spp. | 45 | 0.54 | 2026.624 | 0.242 |
| <i>Chirolophis</i> spp. | 44 | 0.53 | 361.609 | 0.043 |
| <i>Hemilepidotus jordani</i> | 41 | 0.49 | 224.907 | 0.027 |
| <i>Dasytcottus setiger</i> | 40 | 0.48 | 274.199 | 0.033 |
| <i>Bathylagus milleri</i> | 39 | 0.47 | 293.025 | 0.035 |
| <i>Hexagrammos octogrammus</i> | 37 | 0.44 | 714.789 | 0.085 |
| <i>Malacocottus zonurus</i> | 37 | 0.44 | 265.162 | 0.032 |
| <i>Cryptacanthodes gigantea</i> | 36 | 0.43 | 276.190 | 0.033 |
| <i>Microgadus proximus</i> | 35 | 0.42 | 722.255 | 0.086 |
| <i>Stichaeus punctatus</i> | 35 | 0.42 | 224.049 | 0.027 |
| <i>Nannobrachium regale</i> | 33 | 0.39 | 337.580 | 0.040 |
| <i>Tactostoma macropus</i> | 28 | 0.33 | 220.875 | 0.026 |
| <i>Clupea pallasi</i> | 26 | 0.31 | 604.672 | 0.072 |
| <i>Gymnophanrus</i> spp. | 26 | 0.31 | 254.121 | 0.030 |
| <i>Nectoliparis pelagicus</i> | 25 | 0.30 | 155.864 | 0.019 |
| <i>Cyclothone</i> spp. | 23 | 0.27 | 173.651 | 0.021 |

Appendix C - Tables

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| Taxon | No. Positive Hauls | % FO | Sum of Catch/10m ² | Avg. Catch/10m ² |
|--------------------------------------|--------------------------|------|----------------------------------|--------------------------------|
| <i>Triglops forficata</i> | 23 | 0.27 | 146.538 | 0.018 |
| <i>Triglops macellus</i> | 23 | 0.27 | 127.087 | 0.015 |
| <i>Ptilichthys goodei</i> | 22 | 0.26 | 127.541 | 0.015 |
| <i>Trachipterus altivelis</i> | 22 | 0.26 | 159.338 | 0.019 |
| <i>Leptagonus frenatus</i> | 21 | 0.25 | 143.917 | 0.017 |
| <i>Artedioides fenestratus</i> | 18 | 0.22 | 147.778 | 0.018 |
| <i>Bryozoichthys marjorius</i> | 18 | 0.22 | 104.854 | 0.013 |
| <i>Hemilepidotus zapus</i> | 17 | 0.20 | 233.058 | 0.028 |
| <i>Icelinus borealis</i> | 17 | 0.20 | 146.731 | 0.018 |
| <i>Bathyagonus</i> spp. | 16 | 0.19 | 146.158 | 0.017 |
| <i>Anoplagonus inermis</i> | 14 | 0.17 | 88.207 | 0.011 |
| <i>Leptocottus armatus</i> | 14 | 0.17 | 87.974 | 0.011 |
| <i>Bathyagonus nigripinnis</i> | 13 | 0.16 | 83.579 | 0.010 |
| <i>Chirolophis decoratus</i> | 13 | 0.16 | 89.825 | 0.011 |
| <i>Hemitripterus bolini</i> | 13 | 0.16 | 73.340 | 0.009 |
| Hexagrammidae | 12 | 0.14 | 67.882 | 0.008 |
| <i>Limanda aspera</i> | 12 | 0.14 | 82.503 | 0.010 |
| <i>Melamphaes</i> spp. | 12 | 0.14 | 94.387 | 0.011 |
| <i>Icosteus aenigmaticus</i> | 11 | 0.13 | 97.372 | 0.012 |
| <i>Paraliparis</i> spp. | 11 | 0.13 | 108.125 | 0.013 |
| <i>Psychrolutes paradoxus</i> | 11 | 0.13 | 55.906 | 0.007 |
| <i>Scorpaenichthys marmoratus</i> | 11 | 0.13 | 60.297 | 0.007 |
| Scorpaenidae | 11 | 0.13 | 99.762 | 0.012 |
| Zoarcidae⁷ | 11 | 0.13 | 189.707 | 0.023 |
| <i>Chirolophis nugator</i> | 10 | 0.12 | 72.875 | 0.009 |
| <i>Psychrolutes sigalutes</i> | 10 | 0.12 | 75.648 | 0.009 |
| <i>Artedioides</i> spp. | 9 | 0.11 | 112.285 | 0.013 |
| <i>Aptocyclus ventricosus</i> | 8 | 0.10 | 29.985 | 0.004 |
| <i>Aspidophoroides monopterygius</i> | 8 | 0.10 | 42.123 | 0.005 |
| <i>Danaphos oculatus</i> | 8 | 0.10 | 52.603 | 0.006 |
| Ophidiidae | 8 | 0.10 | 80.564 | 0.010 |
| <i>Argyropelecus lychnus</i> | 7 | 0.08 | 44.087 | 0.005 |
| <i>Argyropelecus</i> spp. | 7 | 0.08 | 56.018 | 0.007 |
| <i>Bathyagonus pentacanthus</i> | 7 | 0.08 | 32.764 | 0.004 |
| <i>Bathylagus</i> spp. | 7 | 0.08 | 97.328 | 0.012 |

Appendix C - Tables

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Ranked frequency of occurrence (FO) of larval fish taxa collected in bongo nets from Recruitment Processes Task survey cruises 1972-1996. Average catch (number per 10m²) at positive hauls is included. Total number of 60 cm bongo tows = 8368 (includes 312 Tucker trawls). Bolded taxa are covered in Matarese et al. (2003). Gray taxa are combined at a higher taxonomic level.

| Taxon | No. Positive Hauls | % FO | Sum of Catch/10m ² | Avg. Catch/10m ² |
|---------------------------------------|--------------------------|------|----------------------------------|--------------------------------|
| <i>Bryozoichthys</i> spp. | 7 | 0.08 | 66.791 | 0.008 |
| <i>Embassichthys bathybius</i> | 7 | 0.08 | 41.140 | 0.005 |
| <i>Hexagrammos</i> spp. | 7 | 0.08 | 426.851 | 0.051 |
| <i>Stenobrachius nannochir</i> | 7 | 0.08 | 79.892 | 0.010 |
| <i>Triglops pingeli</i> | 7 | 0.08 | 32.262 | 0.004 |
| <i>Triglops</i> spp. | 7 | 0.08 | 45.628 | 0.005 |
| <i>Cololabis saira</i> | 6 | 0.07 | 44.147 | 0.005 |
| <i>Hypsagonus quadricornis</i> | 6 | 0.07 | 34.101 | 0.004 |
| <i>Melamphaes lugubris</i> | 6 | 0.07 | 54.892 | 0.007 |
| <i>Radulinus</i> spp. | 6 | 0.07 | 36.126 | 0.004 |
| <i>Symbolophorus californiensis</i> | 6 | 0.07 | 44.149 | 0.005 |
| <i>Anoplarchus insignis</i> | 5 | 0.06 | 73.497 | 0.009 |
| <i>Blepsias bilobus</i> | 5 | 0.06 | 41.478 | 0.005 |
| <i>Merluccius productus</i> | 5 | 0.06 | 278.533 | 0.033 |
| <i>Argyropelecus affinis</i> | 4 | 0.05 | 8.297 | 0.001 |
| <i>Hypsagonus mozinoi</i> | 4 | 0.05 | 26.157 | 0.003 |
| <i>Sebastes paucispinis</i> | 4 | 0.05 | 32.029 | 0.004 |
| <i>Xeneretmus latifrons</i> | 4 | 0.05 | 34.464 | 0.004 |
| <i>Brosmophycis marginata</i> | 3 | 0.04 | 21.210 | 0.003 |
| <i>Ceratoscopelus townsendi</i> | 3 | 0.04 | 20.486 | 0.002 |
| <i>Leuroglossus stilbius</i> | 3 | 0.04 | 48.511 | 0.006 |
| Myctophidae B | 3 | 0.04 | 20.000 | 0.002 |
| <i>Nautichthys oculofasciatus</i> | 3 | 0.04 | 16.737 | 0.002 |
| <i>Paricelinus hopliticus</i> | 3 | 0.04 | 55.382 | 0.007 |
| Pholidae | 3 | 0.04 | 19.138 | 0.002 |
| <i>Bathymaster</i> 2 | 2 | 0.02 | 20.344 | 0.002 |
| <i>Bathymaster signatus</i> | 2 | 0.02 | 8.707 | 0.001 |
| Bathymasteridae | 2 | 0.02 | 7.718 | 0.001 |
| <i>Bothragonus swani</i> | 2 | 0.02 | 24.587 | 0.003 |
| <i>Clinocottus</i> spp. | 2 | 0.02 | 13.229 | 0.002 |
| Cottoid type A | 2 | 0.02 | 4.460 | 0.001 |
| <i>Cottus asper</i> | 2 | 0.02 | 13.562 | 0.002 |
| <i>Gasterosteus aculeatus</i> | 2 | 0.02 | 8.222 | 0.001 |
| <i>Icelus</i> spp. | 2 | 0.02 | 18.800 | 0.002 |
| <i>Lepidogobius lepidus</i> | 2 | 0.02 | 12.833 | 0.002 |

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| Taxon | No. Positive Hauls | % FO | Sum of Catch/10m ² | Avg. Catch/10m ² |
|----------------------------------|--------------------------|------|----------------------------------|--------------------------------|
| <i>Liparis florae</i> | 2 | 0.02 | 10.477 | 0.001 |
| <i>Macropinna microstoma</i> | 2 | 0.02 | 12.351 | 0.001 |
| <i>Malacocottus zonurus</i> | 2 | 0.02 | 14.415 | 0.002 |
| <i>Microstoma</i> sp. | 2 | 0.02 | 14.318 | 0.002 |
| <i>Nautichthys robustus</i> | 2 | 0.02 | 10.006 | 0.001 |
| <i>Radulinus boleoides</i> | 2 | 0.02 | 15.379 | 0.002 |
| <i>Rhinoliparis barbulifer</i> | 2 | 0.02 | 16.629 | 0.002 |
| <i>Scopelosaurus</i> spp. | 2 | 0.02 | 14.583 | 0.002 |
| <i>Stellerina xyosterna</i> | 2 | 0.02 | 11.333 | 0.001 |
| <i>Tetragonurus cuvieri</i> | 2 | 0.02 | 20.072 | 0.002 |
| <i>Trachurus symmetricus</i> | 2 | 0.02 | 179.402 | 0.021 |
| <i>Triglops scepticus</i> | 2 | 0.02 | 12.652 | 0.002 |
| <i>Allosmerus elongatus</i> | 1 | 0.01 | 5.579 | 0.001 |
| <i>Anarhichas orientalis</i> | 1 | 0.01 | 9.051 | 0.001 |
| <i>Anoplarchus purpurescens</i> | 1 | 0.01 | 16.782 | 0.002 |
| <i>Argentina sialis</i> | 1 | 0.01 | 8.213 | 0.001 |
| <i>Argyropelecus sladeni</i> | 1 | 0.01 | 8.735 | 0.001 |
| <i>Aristostomias scintillans</i> | 1 | 0.01 | 5.744 | 0.001 |
| <i>Benthalbella dentata</i> | 1 | 0.01 | 7.041 | 0.001 |
| <i>Blepsias cirrhosus</i> | 1 | 0.01 | 13.313 | 0.002 |
| <i>Careproctus</i> spp. | 1 | 0.01 | 9.635 | 0.001 |
| <i>Chitonotus pugetensis</i> | 1 | 0.01 | 6.848 | 0.001 |
| <i>Clevelandia ios</i> | 1 | 0.01 | 3.996 | 0.000 |
| <i>Clinocottus acuticeps</i> | 1 | 0.01 | 39.428 | 0.005 |
| Clupeiformes | 1 | 0.01 | 7.759 | 0.001 |
| <i>Diogenichthys atlanticus</i> | 1 | 0.01 | 8.483 | 0.001 |
| <i>Diogenichthys</i> spp. | 1 | 0.01 | 5.303 | 0.001 |
| <i>Enophrys</i> spp. | 1 | 0.01 | 6.584 | 0.001 |
| <i>Eopsetta jordani</i> | 1 | 0.01 | 8.536 | 0.001 |
| <i>Eurypharynx</i> spp. | 1 | 0.01 | 6.539 | 0.001 |
| <i>Idiacanthus</i> spp. | 1 | 0.01 | 6.272 | 0.001 |
| <i>Leptagonus leptorhynchus</i> | 1 | 0.01 | 2.018 | 0.000 |
| <i>Liparis pulchellus</i> | 1 | 0.01 | 6.368 | 0.001 |
| <i>Loweina rara</i> | 1 | 0.01 | 15.761 | 0.002 |
| <i>Lycodapus</i> spp. | 1 | 0.01 | 7.059 | 0.001 |

Appendix C - Tables

Table 4

Ranked frequency of occurrence (FO) of larval fish taxa collected in bongo nets from Recruitment Processes Task survey cruises 1972-1996. Average catch (number per 10m²) at positive hauls is included. Total number of 60 cm bongo tows = 8368 (includes 312 Tucker trawls). Bolded taxa are covered in Matarese et al. (2003). Gray taxa are combined at a higher taxonomic level.

| Taxon | No. Positive Hauls | % FO | Sum of Catch/10m ² | Avg. Catch/10m ² |
|--|--------------------------|------|----------------------------------|--------------------------------|
| <i>Lycodes brevipes</i> | 1 | 0.01 | 7.626 | 0.001 |
| <i>Lycodes diapterus</i> | 1 | 0.01 | 8.758 | 0.001 |
| <i>Myoxocephalus polyacanthocephalus</i> | 1 | 0.01 | 8.047 | 0.001 |
| <i>Notolepis rissoii</i> | 1 | 0.01 | 8.415 | 0.001 |
| <i>Osmerus mordax</i> | 1 | 0.01 | 6.500 | 0.001 |
| <i>Oxylebius pictus</i> | 1 | 0.01 | 5.060 | 0.001 |
| <i>Pallisina barbata</i> | 1 | 0.01 | 6.571 | 0.001 |
| <i>Paraliparis holomelas</i> | 1 | 0.01 | 8.874 | 0.001 |
| <i>Parvilux ingens</i> | 1 | 0.01 | 8.347 | 0.001 |
| <i>Pholis laeta</i> | 1 | 0.01 | 4.129 | 0.000 |
| <i>Plectobranchus evides</i> | 1 | 0.01 | 6.232 | 0.001 |
| <i>Pleuronichthys coenosus</i> | 1 | 0.01 | 6.580 | 0.001 |
| <i>Rhamphocottus richardsoni</i> | 1 | 0.01 | 2.764 | 0.000 |
| <i>Thaleichthys pacificus</i> | 1 | 0.01 | 8.689 | 0.001 |
| Trachipteridae | 1 | 0.01 | 7.894 | 0.001 |
| <i>Trichodon trichodon</i> | 1 | 0.01 | 3.457 | 0.000 |
| <i>Xiphister</i> spp. | 1 | 0.01 | 5.505 | 0.001 |

¹Species in the study area are *Sebastes aleutianus*, *S.alutus*, *S. auriculatus*, *S. aurora*, *S. babcocki*, *S. borealis*, *S. brevispinis*, *S. caurinus*, *S. chlorostictus*, *S. ciliatus*, *S. crameri*, *S. diploproa*, *S. elongatus*, *S. emphaeus*, *S. entomelas*, *S. flavidus*, *S. glaucus*, *S.goodei*, *S. helvomaculatus*, *S. jordani*, *S. maliger*, *S. melanops*, *S. melanostictus*, *S. miniatus*, *S. mystinus*, *S. nebulosus*, *S. nigrocinctus*, *S. paucispinis*, *S. pinniger*, *S. polyspinis*, *S. proriger*, *S. rastrelliger*, *S. reedi*, *S. ruberrimus*, *S. rufus*, *S. saxicola*, *S. variegatus*, *S. wilsoni*, and *S. zacentrus*.

²Species in the study area are *Allosmerus elongatus*, *Hypomesus pretiosus*, *Mallotus villosus*, *Osmerus mordax*, *Spirinchus starksii*, *S. thaleichthys*, and *Thaleichthys pacificus*.

³Species in the study area are *Myoxocephalus axillaris*, *M. brandti*, *M. jaok*, *M. niger*, *M. polyacanthocephalus*, *M. quadricornis*, *M. scorpius*, *M. stelleri*, and *M. verrucosus*.

⁴Species in the study area are *Albatrossia pectoralis*, *Coryphaenoides acrolepis*, *C. armatus*, *C. cinereus*, *C. filifer*, *C. leptolepis*, *C. liocephalus*, *C. longifilis*, *C. yaquinae*, and *Nezumia stelgidolepis*.

⁵Species found in the study area are *Liparis bristolensis*, *L. callyodon*, *L. catharus*, *L. cyclopus*, *L. dennyi*, *L. florage*, *L. fucensis*, *L. gibbus*, *L. grebnitzki*, *L. marmoratus*, *L. mednus*, *L. megacephalus*, *L. micraspidophorus*, *L. mucosus*, *L. ochotensis*, *L. pulchellus*, *L. rutteri*, and *L.tunicatus*.

Appendix C - Tables

Table 4

Ranked frequency of occurrence (FO) of larval fish taxa collected in bongo nets from Recruitment Processes Task survey cruises 1972-1996. Average catch (number per 10m²) at positive hauls is included. Total number of 60 cm bongo tows = 8368 (includes 312 Tucker trawls). Bolded taxa are covered in Matarese et al. (2003). Gray taxa are combined at a higher taxonomic level.

⁶Species found in the study area are *Melamphaes lugubris*, *Poromitra crassiceps*, and *Scopeloberyx robustus*.

⁷Species in the study area are *Bothocara brunneum*, *B. hollandi*, *B. molle*, *B. pusillum*, *B. remigerum*, *Derepodichthys alepidotus*, *Gymnelis hemifasciatus*, *G. popovi*, *G. viridis*, *Krusensterniella pavlovskii*, *Lycenchelys altus*, *L. camchaticus*, *L. crotalinus*, *L. hippopotamus*, *L. jordani*, *L. longirostris*, *L. microporus*, *L. pliciferus*, *L. rassi*, *L. ratmanovi*, *L. roseus*, *L. volki*, *Lycodapus derjugini*, *L. dermatinus*, *L. endemoscotus*, *L. fierasfer*, *L. leptus*, *L. mandibularis*, *L. pachysoma*, *L. parviceps*, *L. poecilis*, *L. psarosomatus*, *Lycodes brevipes*, *L. concolor*, *L. cortezianus*, *L. diapterus*, *L. mucosus*, *L. pacifica*, *L. palearis*, *L. raridens*, *L. turneri*, *Lyconema barbatum*, *Melanostigma pammelas*, *Nalbantichtys elongatus*, *Opaeophagus acrogeneius*, *Pachycara bulbiceps*, *Puzanovia rubra*, and *Taranetzella lycoderma*.

Appendix C - Tables

Table 5

Larval taxa covered in Matarese et al. (2003).

| Family | Taxon | Common Name |
|-----------------|------------------------------------|---------------------------|
| Engraulidae | <i>Engraulis mordax</i> | Northern anchovy |
| Clupeidae | <i>Clupea pallasi</i> | Pacific herring |
| Microstomatidae | <i>Nansenia candida</i> | Bluethroat argentine |
| Bathylagidae | <i>Bathylagus milleri</i> | Robust blacksmelt |
| | <i>Bathylagus ochotensis</i> | Popeye blacksmelt |
| | <i>Bathylagus pacificus</i> | Pacific blacksmelt |
| | <i>Leuroglossus schmidti</i> | Northern smoothtongue |
| Osmeridae | Osmeridae | Smelts |
| | <i>Mallotus villosus</i> | Capelin |
| Stomiidae | <i>Chauliodus macouni</i> | Pacific viperfish |
| | <i>Tactostoma macropus</i> | Longfin dragonfish |
| Paralepididae | <i>Lestidiops ringens</i> | Slender barracudina |
| Myctophidae | <i>Diaphus theta</i> | California headlightfish |
| | <i>Lampanyctus regalis</i> | Pinpoint lampfish |
| | <i>Lampanyctus ritteri</i> | Broadfin lampfish |
| | <i>Protomyctophum crockeri</i> | California flashlightfish |
| | <i>Protomyctophum thompsoni</i> | Northern flashlightfish |
| | <i>Stenobrachius leucopsarus</i> | Northern lampfish |
| | <i>Tarletonbeania crenularis</i> | Blue lanternfish |
| Trachipteridae | <i>Trachipterus altivelis</i> | King-of-the-salmon |
| Macrouridae | Macrouridae | Grenadiers |
| Merlucciidae | <i>Merluccius productus</i> | Pacific hake |
| Gadidae | <i>Gadus macrocephalus</i> | Pacific cod |
| | <i>Microgadus proximus</i> | Pacific tomcod |
| | <i>Theragra chalcogramma</i> | Walleye pollock |
| Scomberesocidae | <i>Cololabis saira</i> | Pacific saury |
| Melamphaidae | Melamphaidae | Bigscales |
| Scorpaenidae | <i>Sebastes</i> spp. | Rockfishes |
| | <i>Sebastolobus</i> spp. | Thornyheads |
| Anoplopomatidae | <i>Anoplopoma fimbria</i> | Sablefish |
| Hexagrammidae | <i>Hexagrammos decagrammus</i> | Kelp greenling |
| | <i>Hexagrammos lagocephalus</i> | Rock greenling |
| | <i>Hexagrammos octogrammus</i> | Masked greenling |
| | <i>Hexagrammos stelleri</i> | Whitespotted greenling |
| | <i>Ophiodon elongatus</i> | Lingcod |
| | <i>Pleurogrammus monopterygius</i> | Atka mackerel |
| Cottidae | <i>Artedius fenestralis</i> | Padded sculpin |
| | <i>Artedius harringtoni</i> | Scalyhead sculpin |

Appendix C - Tables

Table 5

Larval taxa covered in Matarese et al. (2003).

| Family | Taxon | Common Name |
|-----------------|--------------------------------------|--------------------------|
| Cottidae | <i>Gymnocanthus</i> spp. | |
| | <i>Hemilepidotus hemilepidotus</i> | Red Irish lord |
| | <i>Hemilepidotus jordani</i> | Yellow Irish lord |
| | <i>Hemilepidotus spinosus</i> | Brown Irish lord |
| | <i>Hemilepidotus zapus</i> | Longfin Irish lord |
| | <i>Icelinus</i> spp. | |
| | <i>Leptocottus armatus</i> | Pacific staghorn sculpin |
| | <i>Myoxocephalus</i> spp. | |
| | <i>Radulinus asprellus</i> | Slim sculpin |
| | <i>Ruscarius meanyi</i> | Puget Sound sculpin |
| | <i>Scorpaenichthys marmoratus</i> | Cabezon |
| | <i>Anoplagonus inermis</i> | Smooth alligatorfish |
| | <i>Aspidophoroides monopterygius</i> | Alligatorfish |
| Agonidae | <i>Bathyagonus alascanus</i> | Gray starsnout |
| | <i>Bathyagonus infraspinatus</i> | Spinycheek starsnout |
| | <i>Bathyagonus nigripinnis</i> | Blackfin poacher |
| | <i>Bathyagonus pentacanthus</i> | Bigeye poacher |
| | <i>Hypsagonus mozinoi</i> | Kelp poacher |
| | <i>Hypsagonus quadricornis</i> | Fourhorn poacher |
| | <i>Leptagonus frenatus</i> | Sawback poacher |
| | <i>Podothecus acipenserinus</i> | Sturgeon poacher |
| | <i>Xeneretmus latifrons</i> | Blacktip poacher |
| | <i>Dasy cottus setiger</i> | Spinyhead sculpin |
| | <i>Psychrolutes paradoxus</i> | Tadpole sculpin |
| | <i>Psychrolutes sigalutes</i> | Soft sculpin |
| Cyclopteridae | <i>Aptocyclus ventricosus</i> | Smooth lump sucker |
| | <i>Liparis</i> spp. | Snailfishes |
| Liparidae | <i>Nectoliparis pelagicus</i> | Tadpole snailfish |
| | <i>Bathymaster</i> spp. | |
| Bathymasteridae | <i>Ronquilus jordani</i> | Northern ronquil |
| | <i>Zoarcidae</i> | Eelpouts |
| Zoarcidae | <i>Anoplarchus</i> spp. | Cockscombs |
| | <i>Chirolophis</i> spp. | Warbonnets |
| | <i>Lumpenella longirostris</i> | Longsnout prickleback |
| | <i>Lumpenus</i> spp. | |
| | <i>Lumpenus sagitta</i> | Snake prickleback |
| | <i>Poroclinus rothrocki</i> | Whitebarred prickleback |
| | <i>Stichaeus punctatus</i> | Arctic shanny |

Appendix C - Tables

Table 5

Larval taxa covered in Matarese et al. (2003).

| Family | Taxon | Common Name |
|-------------------|--|---------------------|
| Cryptacanthodidae | <i>Cryptacanthodes aleutensis</i> | Dwarf wrymouth |
| | <i>Cryptacanthodes giganteus</i> | Giant wrymouth |
| Pholidae | <i>Pholis</i> spp. | Gunnels |
| Ptilichthyidae | <i>Ptilichthys goodei</i> | Quillfish |
| Zaproridae | <i>Zaprora silenus</i> | Prowfish |
| Ammodytidae | <i>Ammodytes hexapterus</i> | Pacific sand lance |
| Icosteidae | <i>Icosteus aenigmaticus</i> | Ragfish |
| Centrolophidae | <i>Ichthys lockingtoni</i> | Medusafish |
| Paralichthyidae | <i>Citharichthys sordidus</i> | Pacific sanddab |
| | <i>Citharichthys stigmaeus</i> | Speckled sanddab |
| Pleuronectidae | <i>Atheresthes stomias</i> | Arrowtooth flounder |
| | <i>Embassichthys bathybius</i> | Deepsea sole |
| | <i>Glyptocephalus zachirus</i> | Rex sole |
| | <i>Hippoglossoides elassodon</i> | Flathead sole |
| | <i>Hippoglossus stenolepis</i> | Pacific halibut |
| | <i>Isopsetta isolepis</i> | Butter sole |
| | <i>Lepidotetta bilineata</i> | Southern rock sole |
| | <i>Lepidotetta polyxystra</i> | Northern rock sole |
| | <i>Limanda aspera</i> | Yellowfin sole |
| | <i>Lyopsetta exilis</i> | Slender sole |
| | <i>Microstomus pacificus</i> | Dover sole |
| | <i>Parophrys vetulus</i> | English sole |
| | <i>Platichthys stellatus</i> | Starry flounder |
| | <i>Pleuronectes quadrituberculatus</i> | Alaska plaice |
| | <i>Psettichthys melanostictus</i> | Sand sole |
| | <i>Reinhardtius hippoglossoides</i> | Greenland halibut |

Appendix C - Tables

Table 6

Ranked frequency of occurrence (FO) of pelagic fish egg taxa collected in bongo nets from AFSC survey cruises 1972-1996. Average catch (no./10m²) at positive hauls is included. Total number of 60-cm bongo tows = 8368 (includes 312 Tucker trawls). Bolded taxa are covered in Matarese et al. (2003).

| Taxon | No. Positive Hauls | % FO | Sum of Catch/10m ² | Avg. Catch/10m ² |
|---|-----------------------|-------|----------------------------------|--------------------------------|
| <i>Hippoglossoides elassodon</i> | 2864 | 34.23 | 475785.28 | 166.13 |
| <i>Glyptocephalus zachirus</i> | 1063 | 12.70 | 45043.70 | 42.37 |
| <i>Microstomus pacificus</i> | 870 | 10.40 | 65049.14 | 74.77 |
| Pleuronectidae | 682 | 8.15 | 44669.33 | 65.50 |
| <i>Pleuronectes quadrituberculatus</i> | 622 | 7.43 | 9336.05 | 15.01 |
| <i>Trachipterus altivelis</i> | 353 | 4.22 | 4604.84 | 13.04 |
| Bathylagidae | 328 | 3.92 | 11428.22 | 34.84 |
| <i>Lyopsetta exilis</i> | 245 | 2.93 | 15135.02 | 61.78 |
| Unidentified | 234 | 2.80 | 8267.54 | 35.33 |
| <i>Icichthys lockingtoni</i> | 231 | 2.76 | 3791.03 | 16.41 |
| <i>Chauliodus macouni</i> | 222 | 2.65 | 2603.39 | 11.73 |
| <i>Bathylagus</i> spp. | 202 | 2.41 | 3720.66 | 18.42 |
| Paralichthyidae | 197 | 2.35 | 44053.13 | 223.62 |
| <i>Platichthys stellatus</i> | 176 | 2.10 | 3369.03 | 19.14 |
| Myctophidae | 167 | 2.00 | 66279.60 | 396.88 |
| <i>Macrouridae</i> | 158 | 1.89 | 5852.28 | 37.04 |
| <i>Icosteus aenigmaticus</i> | 145 | 1.73 | 2202.99 | 15.19 |
| <i>Leuroglossus schmidti</i> | 119 | 1.42 | 4840.86 | 40.68 |
| <i>Embassichthys bathybius</i> | 115 | 1.37 | 1017.19 | 8.85 |
| Disintegrated | 94 | 1.12 | 4393.12 | 46.74 |
| <i>Citharichthys</i> spp. | 84 | 1.00 | 3065.76 | 36.50 |
| <i>Parophrys vetulus</i> | 82 | 0.98 | 1876.34 | 22.88 |
| <i>Bathylagus ochotensis</i> | 80 | 0.96 | 1279.03 | 15.99 |
| <i>Isopsetta isolepis</i> | 75 | 0.90 | 1386.28 | 18.48 |
| Teleost type G* | 65 | 0.78 | 1263.05 | 19.43 |
| <i>Psettichthys melanostictus</i> | 55 | 0.66 | 641.14 | 11.66 |
| <i>Limanda aspera</i> | 46 | 0.55 | 1820.18 | 39.57 |
| <i>Merluccius productus</i> | 35 | 0.42 | 508.12 | 14.52 |
| <i>Nansenia candida</i> | 25 | 0.30 | 276.76 | 11.07 |
| <i>Sebastolobus</i> spp. | 24 | 0.29 | 674.45 | 28.10 |
| <i>Tactostoma macropus</i> | 23 | 0.27 | 668.86 | 29.08 |
| <i>Engraulis mordax</i> | 23 | 0.27 | 6792.14 | 295.31 |
| <i>Bathylagus milleri</i> | 21 | 0.25 | 392.56 | 18.69 |
| <i>Reinhardtius hippoglossoides</i> | 20 | 0.24 | 255.59 | 12.78 |
| <i>Hippoglossoides</i> spp. | 20 | 0.24 | 2075.27 | 103.76 |
| <i>Anoplopoma fimbria</i> | 19 | 0.23 | 162.16 | 8.53 |
| Argentinidae | 17 | 0.20 | 143.56 | 8.44 |
| <i>Pleuronichthys decurrens</i> | 15 | 0.18 | 100.99 | 6.73 |

Appendix C - Tables

Table 6

Ranked frequency of occurrence (FO) of pelagic fish egg taxa collected in bongo nets from AFSC survey cruises 1972-1996. Average catch (no./10m²) at positive hauls is included. Total number of 60-cm bongo tows = 8368 (includes 312 Tucker trawls). Bolded taxa are covered in Matarese et al. (2003).

| Taxon | No. Positive Hauls | % FO | Sum of Catch/10m ² | Avg. Catch/10m ² |
|-----------------------------------|-----------------------|------|----------------------------------|--------------------------------|
| Teleost type E* | 13 | 0.16 | 112.18 | 8.63 |
| <i>Tetragonurus cuvieri</i> | 11 | 0.13 | 152.81 | 13.89 |
| <i>Cololabis saira</i> | 10 | 0.12 | 313.08 | 31.31 |
| Teleost type P* | 9 | 0.11 | 160.21 | 17.80 |
| <i>Hippoglossus stenolepis</i> | 8 | 0.10 | 56.96 | 7.12 |
| <i>Nansenia crassa</i> | 7 | 0.08 | 56.41 | 8.06 |
| <i>Gadus macrocephalus</i> | 6 | 0.07 | 65.49 | 10.91 |
| <i>Microstoma</i> sp. | 4 | 0.05 | 29.56 | 7.39 |
| Teleost type C* | 3 | 0.04 | 28.20 | 9.40 |
| <i>Pleuronichthys coenosus</i> | 2 | 0.02 | 21.18 | 10.59 |
| <i>Pleuronichthys verticalis</i> | 1 | 0.01 | 7.72 | 7.72 |
| Teleost type Q* | 1 | 0.01 | 7.37 | 7.37 |
| <i>Bathylagus wesethi</i> | 1 | 0.01 | 5.79 | 5.79 |
| <i>Argentina sialis</i> | 1 | 0.01 | 6.93 | 6.93 |
| <i>Trachurus symmetricus</i> | 1 | 0.01 | 79.83 | 79.83 |
| <i>Hippoglossoides robustus</i> | 1 | 0.01 | 10.84 | 10.84 |
| Teleost type H* | 1 | 0.01 | 6.29 | 6.29 |
| Gonostomatidae | 1 | 0.01 | 6.82 | 6.82 |
| <i>Pleuronectes</i> spp. | 1 | 0.01 | 3.05 | 3.05 |

*Teleost egg types are recognizable by character but remain unidentified.

Appendix C - Tables

Table 7
Pelagic fish egg occurrences covered in Matarese et al. (2003)

| Family | Taxon |
|-----------------|---|
| Engraulidae | <i>Engraulis mordax</i> |
| Microstomatidae | <i>Nansenia candida</i> |
| Bathylagidae | <i>Bathylagus milleri</i> <i>Bathylagus ochotensis</i> <i>Leuroglossus schmidti</i> |
| Stomiidae | <i>Chauliodus macouni</i> <i>Tactostoma macropus</i> |
| Trachipteridae | <i>Trachipterus altivelis</i> |
| Macrouridae | <i>Macrouridae</i> |
| Merlucciidae | <i>Merluccius productus</i> |
| Gadidae | <i>Gadus macrocephalus</i> <i>Theragra chalcogramma</i> |
| Scomberesocidae | <i>Cololabis saira</i> |
| Scorpaenidae | <i>Sebastolobus</i> spp. |
| Anoplopomatidae | <i>Anoplopoma fimbria</i> |
| Icosteidae | <i>Icosteus aenigmaticus</i> |
| Stromateidae | <i>Icichthys lockingtoni</i> |
| Pleuronectidae | <i>Embassichthys bathybius</i> <i>Glyptocephalus zachirus</i> <i>Hippoglossoides elassodon</i> <i>Hippoglossus stenolepis</i> <i>Isopsetta isolepis</i> <i>Limanda aspera</i> <i>Lyopsetta exilis</i> <i>Microstomus pacificus</i> <i>Parophrys vetulus</i> <i>Platichthys stellatus</i> <i>Pleuronectes quadrituberculatus</i> <i>Psettichthys melanostictus</i> <i>Reinhardtius hippoglossoides</i> |

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

| Scientific Name | Common Name | Order | Family (Common) |
|--------------------------------------|----------------------------|-------------------|--|
| <i>Acanthopsetta nadesnyi</i> | Spiny flounder | Pleuronectiformes | Pleuronectidae (Righteye Flounders) |
| <i>Agonopsis vulsa</i> | Northern spearnose poacher | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Albatrossia pectoralis</i> | Giant grenadier | Gadiformes | Macrouridae (Grenadiers) |
| <i>Alepisaurus ferox</i> | Longnose lancetfish | Aulopiformes | Alepisauridae (Lancetfishes) |
| <i>Ammodytes hexapterus</i> | Pacific sand lance | Perciformes | Ammodytidae (Sand Lances) |
| <i>Anarhichas orientalis</i> | Bering wolffish | Perciformes | Anarhichadidae (Wolffishes) |
| <i>Anarrhichthys ocellatus</i> | Wolf-eel | Perciformes | Anarhichadidae (Wolffishes) |
| <i>Anoplagonus inermis</i> | Smooth alligatorfish | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Anoplarchus insignis</i> | Slender cockscomb | Perciformes | Stichaeidae (Picklebacks) |
| <i>Anoplarchus purpureascens</i> | High cockscomb | Perciformes | Stichaeidae (Picklebacks) |
| <i>Anoplogaster cornuta</i> | Fangtooth | Beryciformes | Anoplogastridae (Fangtooths) |
| <i>Anoplopoma fimbria</i> | Sablefish | Scorpaeniformes | Anoplopomatidae (Sablefishes) |
| <i>Anotopterus pharaao</i> | Daggertooth | Aulopiformes | Anotopteridae (Daggertooths) |
| <i>Apodichthys flavidus</i> | Penpoint gunnel | Perciformes | Pholididae (Gunnels) |
| <i>Aptocyclus ventricosus</i> | Smooth lump sucker | Scorpaeniformes | Cyclopteridae (Lumpfishes and Snailfishes) |
| <i>Arctozenus risso</i> | White barracudina | Aulopiformes | Paralepididae (Barracudinas) |
| <i>Argentina sialis</i> | Pacific argentine | Osmeriformes | Argentinidae (Argentines) |
| <i>Argyropelecus affinis</i> | Slender hatchetfish | Stomiiformes | Sternopychidae (Hatchetfishes) |
| <i>Argyropelecus hemigymnus</i> | Spurred hatchetfish | Stomiiformes | Sternopychidae (Hatchetfishes) |
| <i>Argyropelecus lychnus</i> | Tropical hatchetfish | Stomiiformes | Sternopychidae (Hatchetfishes) |
| <i>Argyropelecus sladeni</i> | Lowcrest hatchetfish | Stomiiformes | Sternopychidae (Hatchetfishes) |
| <i>Aristostomias scintillans</i> | Shiny loosejaw | Stomiiformes | Stomiidae (Loosejaws) |
| <i>Artedius fenestralis</i> | Padded sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Artedius harringtoni</i> | Scalyhead sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Artedius lateralis</i> | Smoothhead sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Ascelichthys rhodorus</i> | Rosy lip sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Aspidophoroides monopterygius</i> | Alligatorfish | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Atheresthes evermanni</i> | Kamchatka flounder | Pleuronectiformes | Pleuronectidae (Righteye Flounders) |
| <i>Atheresthes stomias</i> | Arrowtooth flounder | Pleuronectiformes | Pleuronectidae (Righteye Flounders) |
| <i>Atherinops affinis</i> | Topsmelt | Atheriniformes | Atherinidae (Silversides) |
| <i>Atherinopsis californiensis</i> | Jacksmelt | Atheriniformes | Atherinidae (Silversides) |

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

| Scientific Name | Common Name | Order | Family (Common) |
|----------------------------------|------------------------|-------------------|--|
| <i>Aulorhynchus flavidus</i> | Tube-snout | Gasterosteiformes | Gasterosteidae (Sticklebacks) |
| <i>Avocettina infans</i> | Blackline snipe eel | Anguilliformes | Nemichthysidae (Snipe Eels) |
| <i>Bathlagus wesethi</i> | Snubnose blacksmelt | Stomiiformes | Stomiidae (Scaleless Black Dragonfishes) |
| <i>Bathophilus flemingi</i> | Highfin dragonfish | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Bathyagonus alascanus</i> | Gray starsnout | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Bathyagonus infraspinatus</i> | Spinycheek starsnout | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Bathyagonus nigripinnis</i> | Blackfin poacher | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Bathyagonus pentacanthus</i> | Bigeye poacher | Osmeriformes | Bathylagidae (Blacksmelts) |
| <i>Bathylagus bericooides</i> | --- | Osmeriformes | Bathylagidae (Blacksmelts) |
| <i>Bathylagus milleri</i> | Robust blacksmelt | Osmeriformes | Bathylagidae (Blacksmelts) |
| <i>Bathylagus ochotensis</i> | Popeye blacksmelt | Osmeriformes | Bathylagidae (Blacksmelts) |
| <i>Bathylagus pacificus</i> | Pacific blacksmelt | Osmeriformes | Bathylagidae (Blacksmelts) |
| <i>Bathylichnops exilis</i> | Javelin spookfish | Osmeriformes | Opisthoproctidae (Spookfishes) |
| <i>Bathymaster signatus</i> | Searcher | Perciformes | Bathymasteridae (Ronquils) |
| <i>Bathysaurus mollis</i> | Highfin lizardfish | Aulopiformes | Synodontidae (Lizardfishes) |
| <i>Benthalbella dentata</i> | Northern pearleye | Aulopiformes | Scopelarchidae (Pearleyes) |
| <i>Benthalbella linguoidens</i> | Longfin pearleye | Aulopiformes | Scopelarchidae (Pearleyes) |
| <i>Blepsias bilobus</i> | Crested sculpin | Scorpaeniformes | Hemitripteridae (Sculpins) |
| <i>Blepsias cirrhosus</i> | Silverspotted sculpin | Scorpaeniformes | Hemitripteridae (Sculpins) |
| <i>Boreogadus saida</i> | Arctic cod | Gadiformes | Gadidae (Codfishes) |
| <i>Bothragonus swani</i> | Rockhead | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Bothrocara hollandi</i> | Bigfin eelpout | Perciformes | Zoarcidae (Eelpouts) |
| <i>Brama japonica</i> | Pacific pomfret | Perciformes | Bramidae (Pomfrets) |
| <i>Brosmophycis marginata</i> | Red brotula | Ophidiiformes | Bythitidae (Viviparous brotulas) |
| <i>Bryozochthys lysimus</i> | Nutcracker prickleback | Perciformes | Stichaeidae (Pricklebacks) |
| <i>Bryozochthys marjorius</i> | Pearly prickleback | Perciformes | Stichaeidae (Pricklebacks) |
| <i>Caristius macropus</i> | Bigmouth manefish | Perciformes | Caristiidae (Veilfins) |
| <i>Ceratoscopelus townsendi</i> | Dogtooth lampfish | Myctophiformes | Myctophidae (Lanternfishes) |
| <i>Chaenophryne longiceps</i> | Smoothhead dreamer | Lophiiformes | Oneirodidae (Dreamers) |
| <i>Chauliodus macouni</i> | Pacific viperfish | Stomiiformes | Stomiidae (Viperfishes) |
| <i>Chesnonia verrucosa</i> | Warty poacher | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

| Scientific Name | Common Name | Order | Family (Common) |
|-----------------------------------|--------------------------|---------------------|-------------------------------------|
| <i>Chilara taylori</i> | Spotted cusk-eel | Ophidiiformes | Ophidiidae (Cusk-Eels) |
| <i>Chirolophis decoratus</i> | Decorated warbonnet | Perciformes | Stichaeidae (Picklebacks) |
| <i>Chirolophis nugator</i> | Mosshead warbonnet | Perciformes | Stichaeidae (Picklebacks) |
| <i>Chitonotus pugetensis</i> | Roughback sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Citharichthys sordidus</i> | Pacific sanddab | Pleuronectiformes | Paralichthyidae (Lefteye Flounders) |
| <i>Citharichthys stigmaeus</i> | Speckled sanddab | Pleuronectiformes | Paralichthyidae (Lefteye Flounders) |
| <i>Clevelandia ios</i> | Arrow goby | Perciformes | Gobiidae (Gobies) |
| <i>Clinocottus acuticeps</i> | Sharpnose sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Clinocottus embryum</i> | Calico sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Clinocottus globiceps</i> | Mosshead sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Clinocottus recalvus</i> | Bald sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Clupea pallasi</i> | Pacific herring | Clupeiformes | Clupeidae (Herrings) |
| <i>Cololabis saira</i> | Pacific saury | Beloniformes | Scomberesocidae (Sauries) |
| <i>Coryphaenoides acrolepis</i> | Pacific grenadier | Gadiformes | Macrouridae (Grenadiers) |
| <i>Coryphaenoides cinereus</i> | Popeye grenadier | Gadiformes | Macrouridae (Grenadiers) |
| <i>Coryphaenoides filifer</i> | Threadfin grenadier | Gadiformes | Macrouridae (Grenadiers) |
| <i>Coryphaenoides leptolepis</i> | Ghostly grenadier | Gadiformes | Macrouridae (Grenadiers) |
| <i>Cottus asper</i> | Prickly sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Cryptacanthodes aleutensis</i> | Dwarf wrymouth | Perciformes | Cryptacanthodidae (Wrymouths) |
| <i>Cryptacanthodes giganteus</i> | Giant wrymouth | Perciformes | Cryptacanthodidae (Wrymouths) |
| <i>Cyclothona acclinidens</i> | Benttooth bristlemouth | Stomiiformes | Gonostomatidae (Bristlemouths) |
| <i>Cyclothona atraria</i> | Black bristlemouth | Stomiiformes | Gonostomatidae (Bristlemouths) |
| <i>Cyclothona pallida</i> | Tan bristlemouth | Stomiiformes | Gonostomatidae (Bristlemouths) |
| <i>Cyclothona pseudopallida</i> | Slender bristlemouth | Stomiiformes | Gonostomatidae (Bristlemouths) |
| <i>Cyclothona signata</i> | Showy bristlemouth | Stomiiformes | Gonostomatidae (Bristlemouths) |
| <i>Cyema atrum</i> | Bobtail snipe-eel | Saccopharyngiformes | Cyematidae (Bobtail Snipe Eels) |
| <i>Danaphos oculatus</i> | Bottlelight | Stomiiformes | Sternopychidae (Hatchetfishes) |
| <i>Dasycottus setiger</i> | Spinyhead sculpin | Scorpaeniformes | Psychrolutidae (Sculpins) |
| <i>Diaphus theta</i> | California headlightfish | Myctophiformes | Myctophidae (Lanternfishes) |
| <i>Dolichopteryx longipes</i> | Brownsnout spookfish | Osmeriformes | Opisthoproctidae (Spookfishes) |
| <i>Electrona risso</i> | Chubby flashlightfish | Myctophiformes | Myctophidae (Lanternfishes) |

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

| Scientific Name | Common Name | Order | Family (Common) |
|------------------------------------|--------------------------|-------------------|--|
| <i>Eleginus gracilis</i> | Saffron cod | Gadiformes | Gadidae (Codfishes) |
| <i>Embassichthys bathybius</i> | Deepsea sole | Pleuronectiformes | Pleuronectidae (Righeye Flounders) |
| <i>Engraulis mordax</i> | Northern anchovy | Clupeiformes | Engraulidae (Anchovies) |
| <i>Enophryns bison</i> | Buffalo sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Eopsetta jordani</i> | Petrale sole | Pleuronectiformes | Pleuronectidae (Righeye Flounders) |
| <i>Eumicrotremus orbis</i> | Pacific spiny lumpsucker | Scorpaeniformes | Cyclopteridae (Lumpfishes and Snailfishes) |
| <i>Gadus macrocephalus</i> | Pacific cod | Gadiformes | Gadidae (Codfishes) |
| <i>Genyonemus lineatus</i> | White croaker | Perciformes | Sciaenidae (Croakers) |
| <i>Glyptocephalus stelleri</i> | Long flounder | Pleuronectiformes | Pleuronectidae (Righeye Flounders) |
| <i>Glyptocephalus zachirus</i> | Rex sole | Pleuronectiformes | Pleuronectidae (Righeye Flounders) |
| <i>Gobiesox maeandricus</i> | Northern clingfish | Perciformes | Gobiesocidae (Clingfishes) |
| <i>Gonostoma atlanticum</i> | Atlantic fangjaw | Stomiiformes | Gonostomatidae (Bristlemouths) |
| <i>Gonostoma gracile</i> | Slender fangjaw | Stomiiformes | Gonostomatidae (Bristlemouths) |
| <i>Gymnelus viridis</i> | Fish doctor | Perciformes | Zoarcidae (Eelpouts) |
| <i>Gymnophantherus tricuspidis</i> | Arctic staghorn sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Hemilepidotus giberti</i> | Banded Irish lord | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Hemilepidotus hemilepidotus</i> | Red Irish lord | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Hemilepidotus jordani</i> | Yellow Irish lord | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Hemilepidotus spinosus</i> | Brown Irish lord | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Hemilepidotus zapus</i> | Longfin Irish lord | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Hemitripterus bolini</i> | Bigmouth sculpin | Scorpaeniformes | Hemitripteridae (Sculpins) |
| <i>Heterostichus rostratus</i> | Giant kelpfish | Perciformes | Clinidae (Kelpfishes) |
| <i>Hexagrammos decagrammus</i> | Kelp greenling | Scorpaeniformes | Hexagrammidae (Greenlings) |
| <i>Hexagrammos lagocephalus</i> | Rock greenling | Scorpaeniformes | Hexagrammidae (Greenlings) |
| <i>Hexagrammos octogrammus</i> | Masked greenling | Scorpaeniformes | Hexagrammidae (Greenlings) |
| <i>Hexagrammos stelleri</i> | Whitespotted greenling | Scorpaeniformes | Hexagrammidae (Greenlings) |
| <i>Hippoglossoides elassodon</i> | Flathead sole | Pleuronectiformes | Pleuronectidae (Righeye Flounders) |
| <i>Hippoglossoides robustus</i> | Bering flounder | Pleuronectiformes | Pleuronectidae (Righeye Flounders) |
| <i>Hippoglossus stenolepis</i> | Pacific halibut | Pleuronectiformes | Pleuronectidae (Righeye Flounders) |
| <i>Hygophum reinhardtii</i> | Slender lanternfish | Myctophiformes | Myctophidae (Lanternfishes) |
| <i>Hypomesus pretiosus</i> | Surf smelt | Osmeriformes | Osmeridae (Smelts) |

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

| Scientific Name | Common Name | Order | Family (Common) |
|---------------------------------|--------------------------|-------------------|---|
| <i>Hypsagonus mozinoi</i> | Kelp poacher | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Hypsagonus quadricornis</i> | Fourhorn poacher | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Icelinus borealis</i> | Northern sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Icichthys lockingtoni</i> | Medusafish | Perciformes | Centrolophidae (Medusafishes) |
| <i>Icosteus aenigmaticus</i> | Ragfish | Perciformes | Icosteidae (Ragfishes) |
| <i>Idiacanthus antrostomus</i> | Pacific blackdragon | Stomiiformes | Stomiidae (Black dragonsfishes) |
| <i>Idiacanthus fasciola</i> | Ribbon sawtail fish | Stomiiformes | Stomiidae (Black dragonsfishes) |
| <i>Isopsetta isolepis</i> | Butter sole | Pleuronectiformes | Pleuronectidae (Righteye Flounders) |
| <i>Katsuwonus pelamis</i> | Skipjack tuna | Perciformes | Scombridae (Mackerels) |
| <i>Lampadena urophaos</i> | Sunbeam lampfish | Myctophiformes | Myctophidae (Lanternfishes) |
| <i>Lampanyctus ritteri</i> | Broadfin lampfish | Myctophiformes | Myctophidae (Lanternfishes) |
| <i>Lampris guttatus</i> | Opah | Lampriformes | Lampridae (Opahs) |
| <i>Lepidogobius lepidus</i> | Bay goby | Perciformes | Gobiidae (Gobies) |
| <i>Lepidopsetta bilineata</i> | Southern rock sole | Pleuronectiformes | Pleuronectidae (Righteye Flounders) |
| <i>Lepidopsetta polyxystra</i> | Northern rock sole | Pleuronectiformes | Pleuronectidae (Righteye Flounders) |
| <i>Leptagonus decagonus</i> | Atlantic poacher | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Leptagonus frenatus</i> | Sawback poacher | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Leptagonus leptorhynchus</i> | Longnose poacher | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Leptocottus armatus</i> | Pacific staghorn sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Lestidiops ringens</i> | Slender barracudina | Aulopiformes | Paralepididae (Barracudas) |
| <i>Leuroglossus schmidti</i> | Northern smoothtongue | Osmeriformes | Bathylagidae (Blacksmelts) |
| <i>Leuroglossus stilbius</i> | California smoothtongue | Osmeriformes | Bathylagidae (Blacksmelts) |
| <i>Limanda aspera</i> | Yellowfin sole | Pleuronectiformes | Pleuronectidae (Righteye Flounders) |
| <i>Liopsetta glacialis</i> | Arctic flounder | Pleuronectiformes | Pleuronectidae (Righteye Flounders) |
| <i>Liparis calyodon</i> | Spotted snailfish | Scorpaeniformes | Liparidae (Lumpfishes and Snailfishes) |
| <i>Liparis florae</i> | Tidepool snailfish | Scorpaeniformes | Liparidae (Lumpfishes and Snailfishes) |
| <i>Liparis fucensis</i> | Slipskin snailfish | Scorpaeniformes | Liparidae (Lumpfishes and Snailfishes) |
| <i>Liparis gibbus</i> | Variegated snailfish | Scorpaeniformes | Liparidae (Lumpfishes and Snailfishes) |
| <i>Liparis mucosus</i> | Slimy snailfish | Scorpaeniformes | Liparidae (Snailfishes) |
| <i>Liparis pulchellus</i> | Showy snailfish | Scorpaeniformes | Liparidae (Lumpfishes and Snailfishes) |
| <i>Loweina rara</i> | Dwarf lanternfish | Myctophiformes | Myctophidae (Lanternfishes) |

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

| Scientific Name | Common Name | Order | Family (Common) |
|--|-----------------------|----------------------|---|
| <i>Lumpenella longirostris</i> | Longsnout prickleback | Perciformes | Stichaeidae (Pricklebacks) |
| <i>Lumpenus maculatus</i> | Daubed shanny | Perciformes | Stichaeidae (Pricklebacks) |
| <i>Lumpenus sagitta</i> | Snake prickleback | Perciformes | Stichaeidae (Pricklebacks) |
| <i>Luvarus imperialis</i> | Louvar | Perciformes | Luvaridae (Louvars) |
| <i>Lyopsetta exilis</i> | Slender sole | Pleuronectiformes | Pleuronectidae (Righeye Flounders) |
| <i>Macropinna microstoma</i> | Barreleye | Osmeriformes | Opisthoproctidae (Spookfishes) |
| <i>Magnisudis atlantica</i> | Duckbill barracudina | Aulopiformes | Paralepididae (Barracudinas) |
| <i>Malacobocetus zonurus</i> | Darkfin sculpin | Scorpaeniformes | Psychrolutidae (Sculpins) |
| <i>Mallotus villosus</i> | Capelin | Osmeriformes | Osmeridae (Smelts) |
| <i>Melamphaes lugubris</i> | Highsnout bigscale | Stephanoberyciformes | Melamphaidae (Bigscales) |
| <i>Merluccius productus</i> | Pacific hake | Gadiformes | Merlucciidae (Hakes) |
| <i>Microgadus proximus</i> | Pacific tomcod | Gadiformes | Gadidae (Codfishes) |
| <i>Microstomus pacificus</i> | Dover sole | Pleuronectiformes | Pleuronectidae (Righeye Flounders) |
| <i>Mola mola</i> | Ocean sunfish | Tetraodontiformes | Molidae (Molas) |
| <i>Myoxocephalus polyacanthocephalus</i> | Great sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Nannibrachium regale</i> | Pinpoint lampfish | Myctophiformes | Myctophidae (Lanternfishes) |
| <i>Nansenia candida</i> | Bluethroat argentine | Osmeriformes | Microstomatidae (Pencilsmelts) |
| <i>Naucrates ductor</i> | Pilotfish | Perciformes | Carangidae (Jacks) |
| <i>Nautichthys oculofasciatus</i> | Sailfin sculpin | Scorpaeniformes | Hemiripteridae (Sculpins) |
| <i>Nautichthys pribilovius</i> | Eyeshade sculpin | Scorpaeniformes | Hemiripteridae (Sculpins) |
| <i>Nautichthys robustus</i> | Shortmast sculpin | Scorpaeniformes | Hemiripteridae (Sculpins) |
| <i>Nectoliparis pelagicus</i> | Tadpole snailfish | Scorpaeniformes | Liparidae (Lumpfishes and Snailfishes) |
| <i>Nemichthys scolopaceus</i> | Slender snipe eel | Anguilliformes | Nemichthyidae (Snipe Eels) |
| <i>Nezumia stelgidolepis</i> | California grenadier | Gadiformes | Macrouridae (Grenadiers) |
| <i>Occella dodecaedron</i> | Bering poacher | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Odontopyxix trispinsosa</i> | Pygmy poacher | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Oligocottus maculosus</i> | Tidepool sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Oligocottus snyderi</i> | Fluffy sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Oneirodes bulbosus</i> | Bulbous dreamer | Lophiiformes | Oneirodidae (Dreamers) |
| <i>Ophiodon elongatus</i> | Lingcod | Scorpaeniformes | Hexagrammidae (Greenlings) |
| <i>Opisthocentrus ocellatus</i> | Ocellated blenny | Perciformes | Stichaeidae (Pricklebacks) |

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

| Scientific Name | Common Name | Order | Family (Common) |
|-------------------------------------|---------------------------|----------------------|--|
| <i>Opistognathus mitsuii</i> | Pitgum dragonfish | Stomiiformes | Stomiidae (Scaleless Black Dragonfishes) |
| <i>Oxylebius pictus</i> | Painted greenling | Scorpaeniformes | Hexagrammidae (Greenlings) |
| <i>Pallasina barbata</i> | Tubenose poacher | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Paraliparis holomelas</i> | Ebony snailfish | Scorpaeniformes | Liparidae (Lumpfishes and Snailfishes) |
| <i>Paricelinus hopliticus</i> | Thornback sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Parophrys vetulus</i> | English sole | Pleuronectiformes | Pleuronectidae (Righeye Flounders) |
| <i>Parvilux ingens</i> | Giant lampfish | Myctophiformes | Myctophidae (Lanternfishes) |
| <i>Peprilus simillimus</i> | Pacific pompano | Perciformes | Stromateidae (Butterfishes) |
| <i>Percis japonica</i> | Dragon poacher | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Pholis laeta</i> | Crescent gunnel | Perciformes | Pholididae (Gunnels) |
| <i>Phytichthys chirus</i> | Ribbon prickleback | Perciformes | Stichaeidae (Pricklebacks) |
| <i>Platichthys stellatus</i> | Starry flounder | Pleuronectiformes | Pleuronectidae (Righeye Flounders) |
| <i>Plectobranchus evides</i> | Bluebarred prickleback | Perciformes | Stichaeidae (Pricklebacks) |
| <i>Pleurogrammus monopterygius</i> | Atka mackerel | Scorpaeniformes | Hexagrammidae (Greenlings) |
| <i>Pleuronectes quadrifasciatus</i> | Alaska plaice | Pleuronectiformes | Pleuronectidae (Righeye Flounders) |
| <i>Pleuronichthys coenosus</i> | C-O sole | Pleuronectiformes | Pleuronectidae (Righeye Flounders) |
| <i>Pleuronichthys decurrens</i> | Curlfin sole | Pleuronectiformes | Pleuronectidae (Righeye Flounders) |
| <i>Podothecus acipenserinus</i> | Sturgeon poacher | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Poroclinus rothrocki</i> | Whitebarred prickleback | Perciformes | Stichaeidae (Pricklebacks) |
| <i>Poromitra crassiceps</i> | Crested bigscale | Stephanoberyciformes | Melamphaidae (Bigscales) |
| <i>Protomyctophum crockeri</i> | California flashlightfish | Myctophiformes | Myctophidae (Lanternfishes) |
| <i>Protomyctophum thompsoni</i> | Northern flashlightfish | Myctophiformes | Myctophidae (Lanternfishes) |
| <i>Psettidichthys melanostictus</i> | Sand sole | Pleuronectiformes | Pleuronectidae (Righeye Flounders) |
| <i>Psychrolutes paradoxus</i> | Tadpole sculpin | Scorpaeniformes | Psychrolutidae (Sculpins) |
| <i>Psychrolutes phrictus</i> | Blob sculpin | Scorpaeniformes | Psychrolutidae (Sculpins) |
| <i>Psychrolutes sigalutes</i> | Soft sculpin | Scorpaeniformes | Psychrolutidae (Sculpins) |
| <i>Ptilichthys goodei</i> | Quillfish | Perciformes | Ptilichthyidae (Quillfishes) |
| <i>Radulinus asprellus</i> | Slim sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Radulinus boleoides</i> | Darter sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Reinhardtius hippoglossoides</i> | Greenland halibut | Pleuronectiformes | Pleuronectidae (Righeye Flounders) |
| <i>Rhamphocottus richardsoni</i> | Grunt sculpin | Scorpaeniformes | Rhamphocottidae (Sculpins) |

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

| Scientific Name | Common Name | Order | Family (Common) |
|-----------------------------------|-----------------------|----------------------|--|
| <i>Rhinogobiops nicholsii</i> | Blackeye goby | Perciformes | Gobiidae (Gobies) |
| <i>Rhinoliparis barbulifer</i> | Longnose snailfish | Scorpaeniformes | Liparidae (Lumpfishes and Snailfishes) |
| <i>Rimicola muscarum</i> | Kelp clingfish | Perciformes | Gobiesocidae (Clingfishes) |
| <i>Ronquilus jordani</i> | Northern ronquil | Perciformes | Bathymasteridae (Ronquils) |
| <i>Ruscarius meanyi</i> | Puget Sound sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Sardinops sagax</i> | Pacific sardine | Clupeiformes | Clupeidae (Herrings) |
| <i>Scomber japonicus</i> | Chub mackerel | Perciformes | Scombridae (Mackerels) |
| <i>Scopeloberyx robustus</i> | Longjaw bigscale | Stephanoberyciformes | Melamphaidae (Bigscales) |
| <i>Scopelosaurus harryi</i> | Scaly paperbone | Aulopiformes | Notosudidae (Waryfishes) |
| <i>Scorpaenichthys marmoratus</i> | Cabezon | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Sebastes aleutianus</i> | Rougheye rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes auriculatus</i> | Brown rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes aurora</i> | Aurora rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes babcocki</i> | Redbanded rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes caurinus</i> | Copper rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes crameri</i> | Darkblotched rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes diploproa</i> | Splitnose rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes elongatus</i> | Greenstriped rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes emphaeus</i> | Puget Sound rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes entomelas</i> | Widow rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes flavidus</i> | Yellowtail rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes goodei</i> | Chilipepper | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes helvomaculatus</i> | Rosethorn rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes jordani</i> | Shortbelly rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes melanops</i> | Black rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes melanostomus</i> | Blackgill rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes miniatus</i> | Vermilion rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes mystinus</i> | Blue rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes paucispinis</i> | Bocaccio | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes pinniger</i> | Canary rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes polyspinis</i> | Northern rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

| Scientific Name | Common Name | Order | Family (Common) |
|-------------------------------------|------------------------|-------------------|--|
| <i>Sebastes proriger</i> | Redstripe rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes rastrelliger</i> | Grass rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes reedi</i> | Yellowmouth rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes rufus</i> | Bank rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes saxicola</i> | Stripetail rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastes zacentrus</i> | Sharpchin rockfish | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastolobus alascanus</i> | Shortspine thornyhead | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Sebastolobus altivelis</i> | Longspine thornyhead | Scorpaeniformes | Scorpaenidae (Rockfishes) |
| <i>Serrivomer jesperseni</i> | Crossthroat sawpalate | Anguilliformes | Serrivomeridae (Sawtooth Eels) |
| <i>Stellerina xyostema</i> | Pricklebreast poacher | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Stenobrachius leucopsarus</i> | Northern lampfish | Myctophiformes | Myctophidae (Lanternfishes) |
| <i>Sternopyx diaphana</i> | Longspine hatchetfish | Stomiiformes | Sternopychidae (Hatchetfishes) |
| <i>Sternopyx pseudobscura</i> | Highlight hatchetfish | Stomiiformes | Sternopychidae (Hatchetfishes) |
| <i>Stichaeus punctatus</i> | Arctic shanny | Perciformes | Stichaeidae (Picklebacks) |
| <i>Sypholophorus californiensis</i> | California lanternfish | Myctophiformes | Myctophidae (Lanternfishes) |
| <i>Syphurus atricaudus</i> | California tonguefish | Pleuronectiformes | Cynoglossidae (Tonguesoles) |
| <i>Synchirus gilli</i> | Manacled sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Syngnathus leptorhynchus</i> | Bay pipefish | Syngnathiformes | Syngnathidae (Pipefishes and Seahorses) |
| <i>Synodus lucioceps</i> | California lizardfish | Aulopiformes | Synodontidae (Lizardfishes) |
| <i>Tactostoma macropus</i> | Longfin dragonfish | Stomiiformes | Stomiidae (Scaleless Black Dragonfishes) |
| <i>Tarletonbeania crenularis</i> | Blue lanternfish | Myctophiformes | Myctophidae (Lanternfishes) |
| <i>Tetragonurus cuvieri</i> | Smalleye squaretail | Perciformes | Tetragonuridae (Squaretails) |
| <i>Thalassenchelys coheni</i> | --- | Anguilliformes | Chlopsidae (False Morays) |
| <i>Thaleichthys pacificus</i> | Eulachon | Osmeriformes | Osmeridae (Smelts) |
| <i>Theragra chalcogramma</i> | Walleye pollock | Gadiformes | Gadidae (Codfishes) |
| <i>Trachipterus altivelis</i> | King-of-the-salmon | Lampriformes | Trachipteridae (Ribbonfishes) |
| <i>Trachurus symmetricus</i> | Jack mackerel | Perciformes | Carangidae (Jacks) |
| <i>Trichodon trichodon</i> | Pacific sandfish | Perciformes | Trichodontidae (Sandfishes) |
| <i>Triglops forficata</i> | Scissortail sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Triglops macellus</i> | Roughspine sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Triglops pingeli</i> | Ribbed sculpin | Scorpaeniformes | Cottidae (Sculpins) |

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

| Scientific Name | Common Name | Order | Family (Common) |
|--------------------------------|----------------------|-----------------|---|
| <i>Triglops scepticus</i> | Spectacled sculpin | Scorpaeniformes | Cottidae (Sculpins) |
| <i>Ulcina olriki</i> | Arctic alligatorfish | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Xeneretmus latifrons</i> | Blacktip poacher | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Xeneretmus leiops</i> | Smootheye poacher | Scorpaeniformes | Agonidae (Poachers and Alligatorfishes) |
| <i>Xiphister atropurpureus</i> | Black prickleback | Perciformes | Stichaeidae (Pricklebacks) |
| <i>Xiphister mucosus</i> | Rock prickleback | Perciformes | Stichaeidae (Pricklebacks) |
| <i>Zaniolepis frenata</i> | Shortspine combfish | Scorpaeniformes | Hexagrammidae (Greenlings) |
| <i>Zaniolepis latipinnis</i> | Longspine combfish | Scorpaeniformes | Hexagrammidae (Greenlings) |
| <i>Zaprora silenus</i> | Prowfish | Perciformes | Zaproridae (Prowfishes) |

Appendix C - Tables

Table 9

Definitions of symbols used for designating photophore groups in stomiiform fishes (Moser, 1996).

| Deep-bodied sternoptychids | | Other stomiiforms | |
|----------------------------|---|-------------------|---|
| Code | Definition | Code | Definition |
| SO | Subopercle photophore which is equivalent to posteriormost photophore in opercular series of gonostomatids. | SO | Sympyseal photophores (organs) located at tip of lower jaw. |
| PO | Photophore located anterior (<u>pre</u>) to <u>orbit</u> . | Orb | Photophores associated with the eye located anterior and posterior of orbit. |
| PTO | Photophore located <u>posterior to orbit</u> , may be equivalent to upper photophore of opercular series of gonostomatids. | Op | Photophores of <u>opercle</u> series, generally three coded as follows: 1/(1+1). |
| PRO | Pre <u>opercular</u> photophore. | Br(BRP) | Photophores located on the <u>branchiostegal</u> membranes. |
| Br | Same as gonostomatid definition. | Is (I) | Photophores located on the <u>isthmus</u> . |
| Is | Same as gonostomatid definition. | IP | Photophores of the ventral series found from the isthmus to the base of the pectoral fin. |
| AB | Photophores of ventral series located abdominally between pectoral fin base and pelvic fin base and equivalent to PV in gonostomatids, plus a few posterior photophores of the IP series. | PV | Photophores of the ventral series found from the pectoral fin base to the pelvic (ventral) fin base. |
| PAN | Photophores found anterior (<u>pre</u>) to <u>anal</u> fin may be equivalent to VAV or VA in gonostomatids. | VAV | Photophores of the <u>ventral</u> series found from the pelvic (ventral) fin base to the anal fin base. |
| AN | Photophores found above <u>anal</u> fin. | AC | Photophores of the ventral series found from the anal fin base to caudal fin base. |

Appendix C - Tables

Table 9

Definitions of symbols used for designating photophore groups in stomiiform fishes (Moser, 1996).

| Deep-bodied sternoptychids | | Other stomiiforms | |
|----------------------------|---|-------------------|--|
| Code | Definition | Code | Definition |
| SC | Photophores found on lower (<u>sub</u>) caudal peduncle. Together with AN group may be equivalent to AC in gonostomatids. | IC | Summary of photophores of the ventral series from isthmus to caudal fin base (IP+PV+VAV+AC). |
| SAB | Photophores located above (<u>supra</u>) to the <u>abdominal</u> series and may be equivalent to VAL in gonostomatids (SAB lacking in <i>Sternopyx</i>). | IV | Summary of photophores of the ventral series from isthmus to pelvic (ventral) fin base (IP+PV). |
| SP | Photophores located above (<u>supra</u>) the pectoral fin and may be equivalent to OV in gonostomatids. | OV | Photophores of the lateral series from the opercle to pelvic (ventral) fin base. |
| | | VAL (VALA) | Photophores of the lateral series from the pelvic (ventral) fin base to the anal fin base. |
| | | OA (OAA, OAB) | Summary of lateral photophores from the opercle to anal fin base (OV+VA). |
| | | OAC (OC) | Entire lateral series on body just dorsal to ventral series and extending from opercular border, or just medial to it, over anal fin to caudal fin base. |
| | | ODM | Photophores (<u>organs</u>) found dorsal to the lateral midline (found only in <i>Gonostoma gracile</i>). |

Table 10

Collection data for original illustrations by Recruitment Processes Program at Alaska Fisheries Science Center.

| Taxon | SL (mm) | Cruise | Station number | Gear* | Date | Location or N° | W° |
|--------------------------------|---------|--------|----------------|-------------|-----------|-------------------|------------|
| <i>Bathyagonus nigripinnis</i> | 21 | 1OM01 | 23 | MBT | 24-Jul-01 | 56.01 | 169.04 |
| <i>Dasycottus setiger</i> | 17 | 3MF79 | 57 | 6B5 | 1-Jun-79 | | Bering Sea |
| <i>Clupea pallasi</i> | 28 | | | Dip net | 8-May-93 | 47.56 | 123.00 |
| <i>Clupea pallasi</i> | 35 | | | Beach Seine | 22-Jun-93 | 47.57 | 122.55 |
| <i>Gadus macrocephalus</i> | 22 | 5MF91 | C0012A | Methot | 24-Jul-91 | 55.30 | 160.20 |

* Gear

6B5 = 60-cm bongo net, 0.505-mm mesh

MBT = Methot Beam Trawl

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These references pertain to the content section. The references, citations, and footnotes for the data are in the footnote section for each taxon. A complete list of those references can be found on the Citations page.

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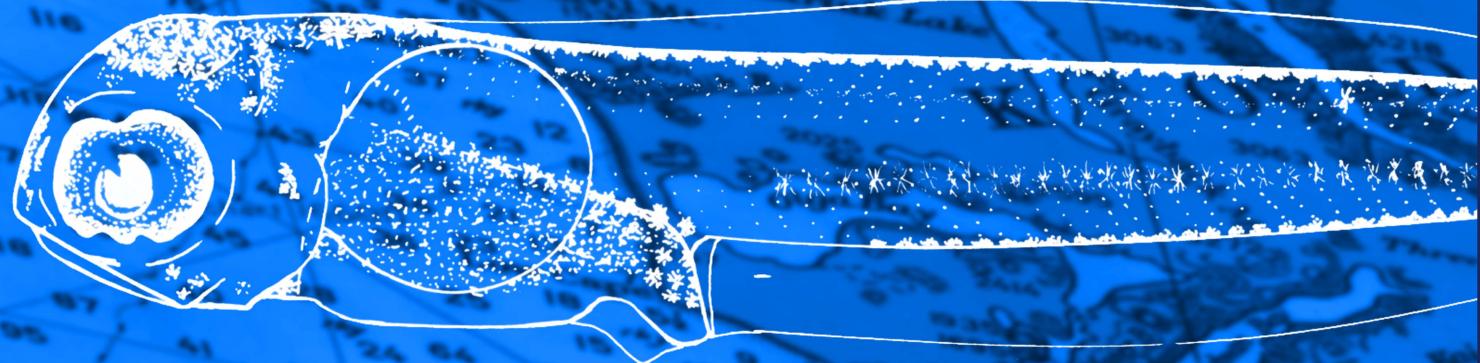
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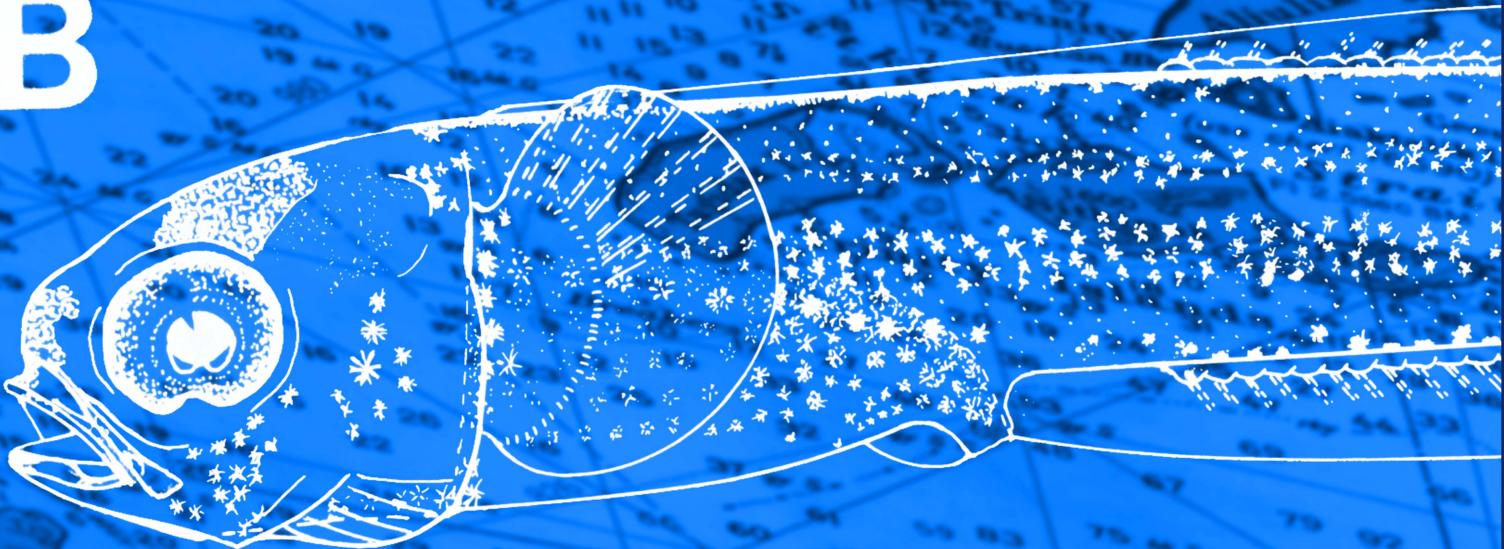
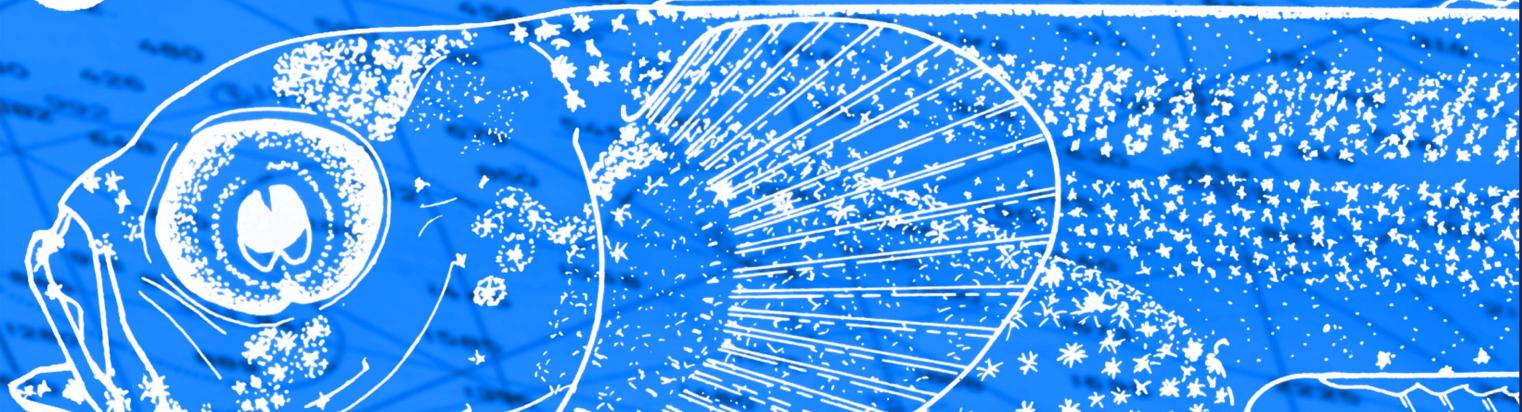
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A

Postanatal ventral midline
present throughout dev

B**C**

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Phylogenetic Species Index

| | | | |
|---------------------------------|-----|-------------------------------------|-----|
| <i>Thalassenchelys coheni</i> | 66 | <i>Bathophilus flemingi</i> | 218 |
| <i>Avocettina infans</i> | 70 | <i>Opostomias mitsuii</i> | 222 |
| <i>Nemichthys scolopaceus</i> | 74 | <i>Tactostoma macropus</i> | 226 |
| <i>Serrivomer jesperseni</i> | 78 | <i>Aristostomias scintillans</i> | 230 |
| <i>Cyema atrum</i> | 82 | <i>Idiacanthus antrostomus</i> | 234 |
| <i>Engraulis mordax</i> | 86 | <i>Idiacanthus fasciola</i> | 238 |
| <i>Clupea pallasi</i> | 90 | <i>Benthalbella dentata</i> | 242 |
| <i>Sardinops sagax</i> | 94 | <i>Benthalbella linguoidens</i> | 246 |
| <i>Argentina sialis</i> | 98 | <i>Scopelosaurus harryi</i> | 250 |
| <i>Nansenia candida</i> | 102 | <i>Bathysaurus mollis</i> | 254 |
| <i>Bathylagus bericoides</i> | 106 | <i>Synodus lucioceps</i> | 258 |
| <i>Bathylagus milleri</i> | 110 | <i>Arctozenus risso</i> | 262 |
| <i>Bathylagus ochotensis</i> | 114 | <i>Lestidiops ringens</i> | 266 |
| <i>Bathylagus pacificus</i> | 118 | <i>Magnisudis atlantica</i> | 270 |
| <i>Bathylagus wesethi</i> | 122 | <i>Anopterous pharao</i> | 274 |
| <i>Leuroglossus schmidti</i> | 126 | <i>Alepisaurus ferox</i> | 278 |
| <i>Leuroglossus stilbius</i> | 130 | <i>Ceratoscopelus townsendi</i> | 282 |
| <i>Bathylychnops exilis</i> | 134 | <i>Diaphus theta</i> | 286 |
| <i>Dolichopteryx longipes</i> | 138 | <i>Electrona risso</i> | 290 |
| <i>Macropinna microstoma</i> | 142 | <i>Hygophum reinhardtii</i> | 294 |
| <i>Hypomesus pretiosus</i> | 146 | <i>Lampadena urophoas</i> | 298 |
| <i>Mallotus villosus</i> | 150 | <i>Nannobrachium regale</i> | 302 |
| <i>Thaleichthys pacificus</i> | 154 | <i>Lampanyctus ritteri</i> | 306 |
| <i>Cyclothona acclinidens</i> | 158 | <i>Loweina rara</i> | 310 |
| <i>Cyclothona atraria</i> | 162 | <i>Parvilux ingens</i> | 314 |
| <i>Cyclothona pallida</i> | 166 | <i>Protomyctophum crockeri</i> | 318 |
| <i>Cyclothona pseudopallida</i> | 170 | <i>Protomyctophum thompsoni</i> | 322 |
| <i>Cyclothona signata</i> | 174 | <i>Stenobrachius leucopsarus</i> | 326 |
| <i>Gonostoma atlanticum</i> | 178 | <i>Symbolophorus californiensis</i> | 330 |
| <i>Gonostoma gracile</i> | 182 | <i>Tarletonbeania crenularis</i> | 334 |
| <i>Argyropelecus affinis</i> | 186 | <i>Lampris guttatus</i> | 338 |
| <i>Argyropelecus hemigymnus</i> | 190 | <i>Trachipterus altivelis</i> | 342 |
| <i>Argyropelecus lychnus</i> | 194 | <i>Chilara taylori</i> | 346 |
| <i>Argyropelecus sladeni</i> | 198 | <i>Brosmophycis marginata</i> | 350 |
| <i>Danaphos oculatus</i> | 202 | <i>Albatrossia pectoralis</i> | 354 |
| <i>Sternopyx diaphana</i> | 206 | <i>Coryphaenoides acrolepis</i> | 358 |
| <i>Sternopyx pseudobscura</i> | 210 | <i>Coryphaenoides cinereus</i> | 362 |
| <i>Chauliodus macouni</i> | 214 | <i>Coryphaenoides filifer</i> | 366 |

Phylogenetic Species Index

| | | | |
|------------------------------------|-----|------------------------------------|-----|
| <i>Coryphaenoides leptolepis</i> | 370 | <i>Sebastes pinniger</i> | 522 |
| <i>Nezumia stelgidolepis</i> | 374 | <i>Sebastes polypinus</i> | 526 |
| <i>Merluccius productus</i> | 378 | <i>Sebastes proriger</i> | 530 |
| <i>Boreogadus saida</i> | 382 | <i>Sebastes rastrelliger</i> | 534 |
| <i>Eleginus gracilis</i> | 386 | <i>Sebastes reedi</i> | 538 |
| <i>Gadus macrocephalus</i> | 390 | <i>Sebastes rufus</i> | 542 |
| <i>Microgadus proximus</i> | 394 | <i>Sebastes saxicola</i> | 546 |
| <i>Theragra chalcogramma</i> | 398 | <i>Sebastes zacentrus</i> | 550 |
| <i>Chaenophryne longiceps</i> | 402 | <i>Sebastolobus alascanus</i> | 554 |
| <i>Oneirodes bulbosus</i> | 406 | <i>Sebastolobus altivelis</i> | 558 |
| <i>Atherinops affinis</i> | 410 | <i>Anoplopoma fimbria</i> | 562 |
| <i>Atherinopsis californiensis</i> | 414 | <i>Hexagrammos decagrammus</i> | 566 |
| <i>Cololabis saira</i> | 418 | <i>Hexagrammos lagocephalus</i> | 570 |
| <i>Melamphaes lugubris</i> | 422 | <i>Hexagrammos octogrammus</i> | 574 |
| <i>Poromitra crassiceps</i> | 426 | <i>Hexagrammos stelleri</i> | 578 |
| <i>Scopeloberyx robustus</i> | 430 | <i>Ophiodon elongatus</i> | 582 |
| <i>Anoplogaster cornuta</i> | 434 | <i>Oxylebius pictus</i> | 586 |
| <i>Aulorhynchus flavidus</i> | 438 | <i>Pleurogrammus monopterygius</i> | 590 |
| <i>Syngnathus leptorhynchus</i> | 442 | <i>Zaniolepis frenata</i> | 594 |
| <i>Sebastes aleutianus</i> | 446 | <i>Zaniolepis latipinnis</i> | 598 |
| <i>Sebastes auriculatus</i> | 450 | <i>Rhamphocottus richardsoni</i> | 602 |
| <i>Sebastes aurora</i> | 454 | <i>Artedius fenestralis</i> | 606 |
| <i>Sebastes babcocki</i> | 458 | <i>Artedius harringtoni</i> | 610 |
| <i>Sebastes caurinus</i> | 462 | <i>Artedius lateralis</i> | 614 |
| <i>Sebastes crameri</i> | 466 | <i>Ascelichthys rhodorus</i> | 618 |
| <i>Sebastes diploproa</i> | 470 | <i>Chitonotus pugetensis</i> | 622 |
| <i>Sebastes elongatus</i> | 474 | <i>Clinocottus acuticeps</i> | 626 |
| <i>Sebastes emphaeus</i> | 478 | <i>Clinocottus embryum</i> | 630 |
| <i>Sebastes entomelas</i> | 482 | <i>Clinocottus globiceps</i> | 634 |
| <i>Sebastes flavidus</i> | 486 | <i>Clinocottus recalvus</i> | 638 |
| <i>Sebastes goodei</i> | 490 | <i>Cottus asper</i> | 642 |
| <i>Sebastes helvomaculatus</i> | 494 | <i>Enophrys bison</i> | 646 |
| <i>Sebastes jordani</i> | 498 | <i>Gymnoanthus tricuspidis</i> | 650 |
| <i>Sebastes melanops</i> | 502 | <i>Hemilepidotus gilberti</i> | 654 |
| <i>Sebastes melanostomus</i> | 506 | <i>Hemilepidotus hemilepidotus</i> | 658 |
| <i>Sebastes miniatus</i> | 510 | <i>Hemilepidotus jordani</i> | 662 |
| <i>Sebastes mystinus</i> | 514 | <i>Hemilepidotus spinosus</i> | 666 |
| <i>Sebastes paucispinis</i> | 518 | <i>Hemilepidotus zapus</i> | 670 |

Phylogenetic Species Index

| | | | |
|--|-----|---------------------------------|-----|
| <i>Icelinus borealis</i> | 674 | <i>Percis japonica</i> | 826 |
| <i>Leptocottus armatus</i> | 678 | <i>Podothecus acipenserinus</i> | 830 |
| <i>Myoxocephalus polyacanthocephalus</i> | 682 | <i>Stellerina xyosterna</i> | 834 |
| <i>Oligocottus maculosus</i> | 686 | <i>Ulcina olriki</i> | 838 |
| <i>Oligocottus snyderi</i> | 690 | <i>Xeneretmus latifrons</i> | 842 |
| <i>Paricelinus hopliticus</i> | 694 | <i>Xeneretmus leiops</i> | 846 |
| <i>Radulinus asprellus</i> | 698 | <i>Dasycottus setiger</i> | 850 |
| <i>Radulinus boleoides</i> | 702 | <i>Malacobottus zonurus</i> | 854 |
| <i>Ruscarius meanyi</i> | 706 | <i>Psychrolutes paradoxus</i> | 858 |
| <i>Scorpaenichthys marmoratus</i> | 710 | <i>Psychrolutes phrictus</i> | 862 |
| <i>Synchirus gilli</i> | 714 | <i>Psychrolutes sigalutes</i> | 866 |
| <i>Triglops forficata</i> | 718 | <i>Aptocyclus ventricosus</i> | 870 |
| <i>Triglops macellus</i> | 722 | <i>Eumicrotremus orbis</i> | 874 |
| <i>Triglops pingeli</i> | 726 | <i>Liparis callyodon</i> | 878 |
| <i>Triglops scepticus</i> | 730 | <i>Liparis florae</i> | 882 |
| <i>Blepsias bilobus</i> | 734 | <i>Liparis fucensis</i> | 886 |
| <i>Blepsias cirrhosus</i> | 738 | <i>Liparis gibbus</i> | 890 |
| <i>Hemitripterus bolini</i> | 742 | <i>Liparis mucosus</i> | 894 |
| <i>Nautichthys oculofasciatus</i> | 746 | <i>Liparis pulchellus</i> | 898 |
| <i>Nautichthys pribilovius</i> | 750 | <i>Nectoliparis pelagicus</i> | 902 |
| <i>Nautichthys robustus</i> | 754 | <i>Paraliparis holomelas</i> | 906 |
| <i>Agonopsis vulsa</i> | 758 | <i>Rhinoliparis barbulifer</i> | 910 |
| <i>Anoplagonus inermis</i> | 762 | <i>Naucrates ductor</i> | 914 |
| <i>Aspidophoroides monopterygius</i> | 766 | <i>Trachurus symmetricus</i> | 918 |
| <i>Bathyagonus alascanus</i> | 770 | <i>Brama japonica</i> | 922 |
| <i>Bathyagonus infraspinatus</i> | 774 | <i>Caristius macropus</i> | 926 |
| <i>Bathyagonus nigripinnis</i> | 778 | <i>Genyonemus lineatus</i> | 930 |
| <i>Bathyagonus pentacanthus</i> | 782 | <i>Bathymaster signatus</i> | 934 |
| <i>Bothragonus swani</i> | 786 | <i>Ronquilus jordani</i> | 938 |
| <i>Chesnonia verrucosa</i> | 790 | <i>Bothrocara hollandi</i> | 942 |
| <i>Hypsagonus mozinoi</i> | 794 | <i>Gymnelus viridis</i> | 946 |
| <i>Hypsagonus quadricornis</i> | 798 | <i>Anoplarchus insignis</i> | 950 |
| <i>Leptagonus decagonus</i> | 802 | <i>Anoplarchus purpurescens</i> | 954 |
| <i>Leptagonus frenatus</i> | 806 | <i>Bryozochthys lysimus</i> | 958 |
| <i>Leptagonus leptorhynchus</i> | 810 | <i>Bryozochthys marjorius</i> | 962 |
| <i>Occella dodecaedron</i> | 814 | <i>Chirolophis decoratus</i> | 966 |
| <i>Odontopyxis trispinosa</i> | 818 | <i>Chirolophis nugator</i> | 970 |
| <i>Pallasina barbata</i> | 822 | <i>Lumpenella longirostris</i> | 974 |

Phylogenetic Species Index

| | | | |
|----------------------------|------|------------------------------|------|
| Lumpenus maculatus | 978 | Eopsetta jordani | 1130 |
| Lumpenus sagitta | 982 | Glyptocephalus stelleri | 1134 |
| Opisthocentrus ocellatus | 986 | Glyptocephalus zachirus | 1138 |
| Phytichthys chirus | 990 | Hippoglossoides elassodon | 1142 |
| Plectobranchus evides | 994 | Hippoglossoides robustus | 1146 |
| Poroclinus rothrocki | 998 | Hippoglossus stenolepis | 1150 |
| Stichaeus punctatus | 1002 | Isopsetta isolepis | 1154 |
| Xiphister atropurpureus | 1006 | Lepidopsetta bilineata | 1158 |
| Xiphister mucosus | 1010 | Lepidopsetta polyxystra | 1162 |
| Cryptacanthodes aleutensis | 1014 | Limanda aspera | 1166 |
| Cryptacanthodes giganteus | 1018 | Liopsetta glacialis | 1170 |
| Apodichthys flavidus | 1022 | Lyopsetta exilis | 1174 |
| Pholis laeta | 1026 | Microstomus pacificus | 1178 |
| Anarhichas orientalis | 1030 | Parophrys vetulus | 1182 |
| Anarrhichthys ocellatus | 1034 | Platichthys stellatus | 1186 |
| Ptilichthys goodei | 1038 | Pleuronectes quadrifasciatus | 1190 |
| Zaprora silenus | 1042 | Pleuronichthys coenosus | 1194 |
| Trichodon trichodon | 1046 | Pleuronichthys decurrens | 1198 |
| Ammodytes hexapterus | 1050 | Psettichthys melanostictus | 1202 |
| Heterostichus rostratus | 1054 | Reinhardtius hippoglossoides | 1206 |
| Icosteus aenigmaticus | 1058 | Symphurus atricaudus | 1210 |
| Gobiesox maeandricus | 1062 | Mola mola | 1214 |
| Rimicola muscarum | 1066 | | |
| Clevelandia ios | 1070 | | |
| Rhinogobiops nicholsii | 1074 | | |
| Lepidogobius lepidus | 1078 | | |
| Luvarus imperialis | 1082 | | |
| Katsuwonus pelamis | 1086 | | |
| Scomber japonicus | 1090 | | |
| Icichthys lockingtoni | 1094 | | |
| Tetragonurus cuvieri | 1098 | | |
| Peprilus simillimus | 1102 | | |
| Citharichthys sordidus | 1106 | | |
| Citharichthys stigmaeus | 1110 | | |
| Acanthopsetta nadeshnyi | 1114 | | |
| Atheresthes evermanni | 1118 | | |
| Atheresthes stomias | 1122 | | |
| Embassichthys bathybius | 1126 | | |

Alphabetic Species Index

| | | | |
|-------------------------------|------|--------------------------|------|
| Acanthopsetta nadeshnyi | 1114 | Bathylagus bericoides | 106 |
| Agonopsis vulsa | 758 | Bathylagus milleri | 110 |
| Albatrossia pectoralis | 354 | Bathylagus ochotensis | 114 |
| Alepisaurus ferox | 278 | Bathylagus pacificus | 118 |
| Ammodytes hexapterus | 1050 | Bathylagus wesethi | 122 |
| Anarhichas orientalis | 1030 | Bathylychnops exilis | 134 |
| Anarrhichthys ocellatus | 1034 | Bathymaster signatus | 934 |
| Anoplagonus inermis | 762 | Bathysaurus mollis | 254 |
| Anoplarchus insignis | 950 | Benthalbella dentata | 242 |
| Anoplarchus purpureescens | 954 | Benthalbella linguoidens | 246 |
| Anoplogaster cornuta | 434 | Blepsias bilobus | 734 |
| Anoplopoma fimbria | 562 | Blepsias cirrhosus | 738 |
| Anotopterus pharao | 274 | Boreogadus saida | 382 |
| Apodichthys flavidus | 1022 | Bothragonus swani | 786 |
| Aptocyclus ventricosus | 870 | Bothrocara hollandi | 942 |
| Arctozenus risso | 262 | Brama japonica | 922 |
| Argentina sialis | 98 | Brosmophycis marginata | 350 |
| Argyropelecus affinis | 186 | Bryozoichthys lysimus | 958 |
| Argyropelecus hemigymnus | 190 | Bryozoichthys marjorius | 962 |
| Argyropelecus lychnus | 194 | Caristius macropus | 926 |
| Argyropelecus sladeni | 198 | Ceratoscopelus townsendi | 282 |
| Aristostomias scintillans | 230 | Chaenophryne longiceps | 402 |
| Artedius fenestralis | 606 | Chauliodus macouni | 214 |
| Artedius harringtoni | 610 | Chesnonia verrucosa | 790 |
| Artedius lateralis | 614 | Chilara taylori | 346 |
| Ascelichthys rhodorus | 618 | Chiroliphis decoratus | 966 |
| Aspidophoroides monopterygius | 766 | Chiroliphis nugator | 970 |
| Atheresthes evermanni | 1118 | Chitonotus pugetensis | 622 |
| Atheresthes stomias | 1122 | Citharichthys sordidus | 1106 |
| Atherinops affinis | 410 | Citharichthys stigmaeus | 1110 |
| Atherinopsis californiensis | 414 | Clevelandia ios | 1070 |
| Aulorhynchus flavidus | 438 | Clinocottus acuticeps | 626 |
| Avocettina infans | 70 | Clinocottus embryum | 630 |
| Bathophilus flemingi | 218 | Clinocottus globiceps | 634 |
| Bathyagonus alascanus | 770 | Clinocottus recalvus | 638 |
| Bathyagonus infraspinatus | 774 | Clupea pallasi | 90 |
| Bathyagonus nigripinnis | 778 | Cololabis saira | 418 |
| Bathyagonus pentacanthus | 782 | Coryphaenoides acrolepis | 358 |

Alphabetic Species Index

| | | | |
|------------------------------------|------|----------------------------------|------|
| <i>Coryphaenoides cinereus</i> | 362 | <i>Heterostichus rostratus</i> | 1054 |
| <i>Coryphaenoides filifer</i> | 366 | <i>Hexagrammos decagrammus</i> | 566 |
| <i>Coryphaenoides leptolepis</i> | 370 | <i>Hexagrammos lagocephalus</i> | 570 |
| <i>Cottus asper</i> | 642 | <i>Hexagrammos octogrammus</i> | 574 |
| <i>Cryptacanthodes aleutensis</i> | 1014 | <i>Hexagrammos stelleri</i> | 578 |
| <i>Cryptacanthodes giganteus</i> | 1018 | <i>Hippoglossoides elassodon</i> | 1142 |
| <i>Cyclothona acclinidens</i> | 158 | <i>Hippoglossoides robustus</i> | 1146 |
| <i>Cyclothona atraria</i> | 162 | <i>Hippoglossus stenolepis</i> | 1150 |
| <i>Cyclothona pallida</i> | 166 | <i>Hygophum reinhardtii</i> | 294 |
| <i>Cyclothona pseudopallida</i> | 170 | <i>Hypomesus pretiosus</i> | 146 |
| <i>Cyclothona signata</i> | 174 | <i>Hypsagonus mozinoi</i> | 794 |
| <i>Cyema atrum</i> | 82 | <i>Hypsagonus quadricornis</i> | 798 |
| <i>Danaphos oculatus</i> | 202 | <i>Icelinus borealis</i> | 674 |
| <i>Dasycottus setiger</i> | 850 | <i>Icichthys lockingtoni</i> | 1094 |
| <i>Diaphus theta</i> | 286 | <i>Icosteus aenigmaticus</i> | 1058 |
| <i>Dolichopteryx longipes</i> | 138 | <i>Idiacanthus antrostomus</i> | 234 |
| <i>Electrona risso</i> | 290 | <i>Idiacanthus fasciola</i> | 238 |
| <i>Eleginops gracilis</i> | 386 | <i>Isopsetta isolepis</i> | 1154 |
| <i>Embassichthys bathybius</i> | 1126 | <i>Katsuwonus pelamis</i> | 1086 |
| <i>Engraulis mordax</i> | 86 | <i>Lampadena urophaois</i> | 298 |
| <i>Enophrys bison</i> | 646 | <i>Lampanyctus ritteri</i> | 306 |
| <i>Eopsetta jordani</i> | 1130 | <i>Lampris guttatus</i> | 338 |
| <i>Eumicrotremus orbis</i> | 874 | <i>Lepidogobius lepidus</i> | 1078 |
| <i>Gadus macrocephalus</i> | 390 | <i>Lepidopsetta bilineata</i> | 1158 |
| <i>Genyonemus lineatus</i> | 930 | <i>Lepidopsetta polyxystra</i> | 1162 |
| <i>Glyptocephalus stelleri</i> | 1134 | <i>Leptagonus decagonus</i> | 802 |
| <i>Glyptocephalus zachirus</i> | 1138 | <i>Leptagonus frenatus</i> | 806 |
| <i>Gobiesox maeandricus</i> | 1062 | <i>Leptagonus leptorhynchus</i> | 810 |
| <i>Gonostoma atlanticum</i> | 178 | <i>Leptocottus armatus</i> | 678 |
| <i>Gonostoma gracile</i> | 182 | <i>Lestidiops ringens</i> | 266 |
| <i>Gymnelus viridis</i> | 946 | <i>Leuroglossus schmidti</i> | 126 |
| <i>Gymnophanrus tricuspidis</i> | 650 | <i>Leuroglossus stilbius</i> | 130 |
| <i>Hemilepidotus gilberti</i> | 654 | <i>Limanda aspera</i> | 1166 |
| <i>Hemilepidotus hemilepidotus</i> | 658 | <i>Liopsetta glacialis</i> | 1170 |
| <i>Hemilepidotus jordani</i> | 662 | <i>Liparis callyodon</i> | 878 |
| <i>Hemilepidotus spinosus</i> | 666 | <i>Liparis florate</i> | 882 |
| <i>Hemilepidotus zapus</i> | 670 | <i>Liparis fucensis</i> | 886 |
| <i>Hemitripterus bolini</i> | 742 | <i>Liparis gibbus</i> | 890 |

Alphabetic Species Index

| | | | |
|-----------------------------------|------|------------------------------|------|
| Liparis mucosus | 894 | Paricelinus hopliticus | 694 |
| Liparis pulchellus | 898 | Parophrys vetulus | 1182 |
| Loweina rara | 310 | Parvilux ingens | 314 |
| Lumpenella longirostris | 974 | Peprilus simillimus | 1102 |
| Lumpenus maculatus | 978 | Percis japonica | 826 |
| Lumpenus sagitta | 982 | Pholis laeta | 1026 |
| Luvarus imperialis | 1082 | Phytichthys chiru | 990 |
| Lyopsetta exilis | 1174 | Platichthys stellatus | 1186 |
| Macropinna microstoma | 142 | Plectobranchus evides | 994 |
| Magnisudis atlantica | 270 | Pleurogrammus monopterygius | 590 |
| Malacocottus zonurus | 854 | Pleuronectes quadrifasciatus | 1190 |
| Mallotus villosus | 150 | Pleuronichthys coenosus | 1194 |
| Melamphaes lugubris | 422 | Pleuronichthys decurrens | 1198 |
| Merluccius productus | 378 | Podothecus acipenserinus | 830 |
| Microgadus proximus | 394 | Poroclinus rothrocki | 998 |
| Microstomus pacificus | 1178 | Poromitra crassiceps | 426 |
| Mola mola | 1214 | Protomyctophum crockeri | 318 |
| Myoxocephalus polyacanthocephalus | 682 | Protomyctophum thompsoni | 322 |
| Nannobrachium regale | 302 | Psettichthys melanostictus | 1202 |
| Nansenia candida | 102 | Psychrolutes paradoxus | 858 |
| Naucrates ductor | 914 | Psychrolutes phrictus | 862 |
| Nautichthys oculofasciatus | 746 | Psychrolutes sigalutes | 866 |
| Nautichthys pribilovius | 750 | Ptilichthys goodei | 1038 |
| Nautichthys robustus | 754 | Radulinus asprellus | 698 |
| Nectoliparis pelagicus | 902 | Radulinus boleoides | 702 |
| Nemichthys scolopaceus | 74 | Reinhardtius hippoglossoides | 1206 |
| Nezumia stelgidolepis | 374 | Rhamphocottus richardsoni | 602 |
| Occella dodecaedron | 814 | Rhinogobiops nicholsii | 1074 |
| Odontopyxis trispinosa | 818 | Rhinoliparis barbulifer | 910 |
| Oligocottus maculosus | 686 | Rimicola muscarum | 1066 |
| Oligocottus snyderi | 690 | Ronquilus jordani | 938 |
| Oneirodes bulbosus | 406 | Ruscarius meanyi | 706 |
| Ophiodon elongatus | 582 | Sardinops sagax | 94 |
| Opisthocentrus ocellatus | 986 | Scomber japonicus | 1090 |
| Opostomias mitsuii | 222 | Scopeloberyx robustus | 430 |
| Oxylebius pictus | 586 | Scopelosaurus harryi | 250 |
| Pallasina barbata | 822 | Scorpaenichthys marmoratus | 710 |
| Paraliparis holomelas | 906 | Sebastes aleutianus | 446 |

Alphabetic Species Index

| | | | |
|-------------------------------------|------|----------------------------------|------|
| <i>Sebastes auriculatus</i> | 450 | <i>Synodus lucioceps</i> | 258 |
| <i>Sebastes aurora</i> | 454 | <i>Tactostoma macropus</i> | 226 |
| <i>Sebastes babcocki</i> | 458 | <i>Tarletonbeania crenularis</i> | 334 |
| <i>Sebastes caurinus</i> | 462 | <i>Tetragonurus cuvieri</i> | 1098 |
| <i>Sebastes crameri</i> | 466 | <i>Thalassenchelys coheni</i> | 66 |
| <i>Sebastes diploproa</i> | 470 | <i>Thaleichthys pacificus</i> | 154 |
| <i>Sebastes elongatus</i> | 474 | <i>Theragra chalcogramma</i> | 398 |
| <i>Sebastes emphaeus</i> | 478 | <i>Trachipterus altivelis</i> | 342 |
| <i>Sebastes entomelas</i> | 482 | <i>Trachurus symmetricus</i> | 918 |
| <i>Sebastes flavidus</i> | 486 | <i>Trichodon trichodon</i> | 1046 |
| <i>Sebastes goodei</i> | 490 | <i>Triglops forficata</i> | 718 |
| <i>Sebastes helvomaculatus</i> | 494 | <i>Triglops macellus</i> | 722 |
| <i>Sebastes jordani</i> | 498 | <i>Triglops pingeli</i> | 726 |
| <i>Sebastes melanops</i> | 502 | <i>Triglops scepticus</i> | 730 |
| <i>Sebastes melanostomus</i> | 506 | <i>Ulcina olriki</i> | 838 |
| <i>Sebastes miniatus</i> | 510 | <i>Xeneretmus latifrons</i> | 842 |
| <i>Sebastes mystinus</i> | 514 | <i>Xeneretmus leiops</i> | 846 |
| <i>Sebastes paucispinis</i> | 518 | <i>Xiphister atropurpureus</i> | 1006 |
| <i>Sebastes pinniger</i> | 522 | <i>Xiphister mucosus</i> | 1010 |
| <i>Sebastes polystpinis</i> | 526 | <i>Zanolepis frenata</i> | 594 |
| <i>Sebastes proriger</i> | 530 | <i>Zanolepis latipinnis</i> | 598 |
| <i>Sebastes rastrelliger</i> | 534 | <i>Zaprora silenus</i> | 1042 |
| <i>Sebastes reedi</i> | 538 | | |
| <i>Sebastes rufus</i> | 542 | | |
| <i>Sebastes saxicola</i> | 546 | | |
| <i>Sebastes zacentrus</i> | 550 | | |
| <i>Sebastolobus alascanus</i> | 554 | | |
| <i>Sebastolobus altivelis</i> | 558 | | |
| <i>Serrivomer jesperseni</i> | 78 | | |
| <i>Stellerina xyosterna</i> | 834 | | |
| <i>Stenobrachius leucopsarus</i> | 326 | | |
| <i>Sternoptyx diaphana</i> | 206 | | |
| <i>Sternoptyx pseudobscura</i> | 210 | | |
| <i>Stichaeus punctatus</i> | 1002 | | |
| <i>Symbolophorus californiensis</i> | 330 | | |
| <i>Syphurus atricaudus</i> | 1210 | | |
| <i>Synchirus gilli</i> | 714 | | |
| <i>Syngnathus leptorhynchus</i> | 442 | | |

Common Name Species Index

| | | | |
|-------------------------|------|---------------------------|------|
| Alaska plaice | 1190 | Bluethroat argentine | 102 |
| Alligatorfish | 766 | Bobtail snipe-eel | 82 |
| Arctic alligatorfish | 838 | Bocaccio | 518 |
| Arctic cod | 382 | Bottlelight | 202 |
| Arctic flounder | 1170 | Broadfin lampfish | 306 |
| Arctic shanny | 1002 | Brown Irish lord | 666 |
| Arctic staghorn sculpin | 650 | Brown rockfish | 450 |
| Arrow goby | 1070 | Brownsnout spookfish | 138 |
| Arrowtooth flounder | 1122 | Buffalo sculpin | 646 |
| Atka mackerel | 590 | Bulbous dreamer | 406 |
| Atlantic fangjaw | 178 | Butter sole | 1154 |
| Atlantic poacher | 802 | Cabezon | 710 |
| Aurora rockfish | 454 | Calico sculpin | 630 |
| Bald sculpin | 638 | California flashlightfish | 318 |
| Banded Irish lord | 654 | California grenadier | 374 |
| Bank rockfish | 542 | California headlightfish | 286 |
| Barreleye | 142 | California lanternfish | 330 |
| Bay goby | 1078 | California lizardfish | 258 |
| Bay pipefish | 442 | California smoothtongue | 130 |
| Benttooth bristlemouth | 158 | California tonguefish | 1210 |
| Bering flounder | 1146 | Canary rockfish | 522 |
| Bering poacher | 814 | Capelin | 150 |
| Bering wolffish | 1030 | Chilipepper | 490 |
| Bigeye poacher | 782 | Chub mackerel | 1090 |
| Bigmouth manefish | 926 | Chubby flashlightfish | 290 |
| Bigmouth sculpin | 742 | C-O sole | 1194 |
| Black bristlemouth | 162 | Copper rockfish | 462 |
| Black prickleback | 1006 | Crescent gunnel | 1026 |
| Black rockfish | 502 | Crested bigscale | 426 |
| Blackeye goby | 1074 | Crested sculpin | 734 |
| Blackfin poacher | 778 | Crossthroat sawpalate | 78 |
| Blackgill rockfish | 506 | Curlfin sole | 1198 |
| Blackline snipe eel | 70 | Daggetooth | 274 |
| Blacktip poacher | 842 | Darkblotched rockfish | 466 |
| Blob sculpin | 862 | Darkfin sculpin | 854 |
| Blue lanternfish | 334 | Darter sculpin | 702 |
| Blue rockfish | 514 | Daubed shanny | 978 |
| Bluebarred prickleback | 994 | Decorated warbonnet | 966 |

Common Name Species Index

| | | | |
|-----------------------|------|----------------------------|------|
| Deepsea sole | 1126 | Kelp greenling | 566 |
| Dogtooth lampfish | 282 | Kelp poacher | 794 |
| Dover sole | 1178 | King-of-the-salmon | 342 |
| Dragon poacher | 826 | Lingcod | 582 |
| Duckbill barracudina | 270 | Long flounder | 1134 |
| Dwarf lanternfish | 310 | Longfin dragonfish | 226 |
| Dwarf wrymouth | 1014 | Longfin Irish lord | 670 |
| Ebony snailfish | 906 | Longfin pearleye | 246 |
| English sole | 1182 | Longjaw bigscale | 430 |
| Eulachon | 154 | Longnose lancetfish | 278 |
| Eyeshade sculpin | 750 | Longnose poacher | 810 |
| Fangtooth | 434 | Longnose snailfish | 910 |
| Fish doctor | 946 | Longsnout prickleback | 974 |
| Flathead sole | 1142 | Longspine combfish | 598 |
| Fluffy sculpin | 690 | Longspine hatchetfish | 206 |
| Fourhorn poacher | 798 | Longspine thornyhead | 558 |
| Ghostly grenadier | 370 | Louvar | 1082 |
| Giant grenadier | 354 | Lowcrest hatchetfish | 198 |
| Giant kelpfish | 1054 | Manacled sculpin | 714 |
| Giant lampfish | 314 | Masked greenling | 574 |
| Giant wrymouth | 1018 | Medusafish | 1094 |
| Grass rockfish | 534 | Mosshead sculpin | 634 |
| Gray starsnout | 770 | Mosshead warbonnet | 970 |
| Great sculpin | 682 | Northern anchovy | 86 |
| Greenland halibut | 1206 | Northern clingfish | 1062 |
| Greenstriped rockfish | 474 | Northern flashlightfish | 322 |
| Grunt sculpin | 602 | Northern lampfish | 326 |
| High cockscomb | 954 | Northern pearleye | 242 |
| Highfin dragonfish | 218 | Northern rock sole | 1162 |
| Highfin lizardfish | 254 | Northern rockfish | 526 |
| Highlight hatchetfish | 210 | Northern ronquil | 938 |
| Highsnout bigscale | 422 | Northern sculpin | 674 |
| Jack mackerel | 918 | Northern smoothtongue | 126 |
| Jacksmelt | 414 | Northern spearnose poacher | 758 |
| Japan eelpout | 942 | Nutcracker prickleback | 958 |
| Javelin spookfish | 134 | Ocean sunfish | 1214 |
| Kamchatka flounder | 1118 | Ocellated blenny | 986 |
| Kelp clingfish | 1066 | Opah | 338 |

Common Name Species Index

| | | | |
|--------------------------|------|-----------------------|------|
| Pacific argentine | 98 | Red Irish lord | 658 |
| Pacific blackdragon | 234 | Redbanded rockfish | 458 |
| Pacific blacksmelt | 118 | Redstripe rockfish | 530 |
| Pacific cod | 390 | Rex sole | 1138 |
| Pacific grenadier | 358 | Ribbed sculpin | 726 |
| Pacific hake | 378 | Ribbon prickleback | 990 |
| Pacific halibut | 1150 | Ribbon sawtail fish | 238 |
| Pacific herring | 90 | Robust blacksmelt | 110 |
| Pacific pomfret | 922 | Rock greenling | 570 |
| Pacific pompano | 1102 | Rock prickleback | 1010 |
| Pacific sand lance | 1050 | Rockhead | 786 |
| Pacific sanddab | 1106 | Rosehorn rockfish | 494 |
| Pacific sandfish | 1046 | Rosy lip sculpin | 618 |
| Pacific sardine | 94 | Roughback sculpin | 622 |
| Pacific saury | 418 | Rougheye rockfish | 446 |
| Pacific spiny lumpsucker | 874 | Roughspine sculpin | 722 |
| Pacific staghorn sculpin | 678 | Sablefish | 562 |
| Pacific tomcod | 394 | Saffron cod | 386 |
| Pacific viperfish | 214 | Sailfin sculpin | 746 |
| Padded sculpin | 606 | Sand sole | 1202 |
| Painted greenling | 586 | Sawback poacher | 806 |
| Pearly prickleback | 962 | Scaly paperbone | 250 |
| Penpoint gunnel | 1022 | Scalyhead sculpin | 610 |
| Petrale sole | 1130 | Scissortail sculpin | 718 |
| Pilotfish | 914 | Searcher | 934 |
| Pinpoint lampfish | 302 | Sharpchin rockfish | 550 |
| Pitgum dragonfish | 222 | Sharpnose sculpin | 626 |
| Popeye blacksmelt | 114 | Shiny loosejaw | 230 |
| Popeye grenadier | 362 | Shortbelly rockfish | 498 |
| Pricklebreast poacher | 834 | Shortmast sculpin | 754 |
| Prickly sculpin | 642 | Shortspine combfish | 594 |
| Prowfish | 1042 | Shortspine thornyhead | 554 |
| Puget sound rockfish | 478 | Showy bristlemouth | 174 |
| Puget sound sculpin | 706 | Showy snailfish | 898 |
| Pygmy poacher | 818 | Silverspotted sculpin | 738 |
| Quillfish | 1038 | Skipjack tuna | 1086 |
| Ragfish | 1058 | Slender barracudina | 266 |
| Red brotula | 350 | Slender bristlemouth | 170 |

Common Name Species Index

| | | | |
|----------------------|------|-------------------------|------|
| Slender cockscomb | 950 | Tidepool sculpin | 686 |
| Slender fangjaw | 182 | Tidepool snailfish | 882 |
| Slender hatchetfish | 186 | Topsmelt | 410 |
| Slender lanternfish | 294 | Tropical hatchetfish | 194 |
| Slender snipe eel | 74 | Tubenose poacher | 822 |
| Slender sole | 1174 | Tube-snout | 438 |
| Slim sculpin | 698 | Variegated snailfish | 890 |
| Slimy snailfish | 894 | Vermilion rockfish | 510 |
| Slipskin snailfish | 886 | Walleye pollock | 398 |
| Smalleye squaretail | 1098 | Warty poacher | 790 |
| Smooth alligatorfish | 762 | White barracudina | 262 |
| Smooth lump sucker | 870 | White croaker | 930 |
| Smootheye poacher | 846 | Whitebarred prickleback | 998 |
| Smoothhead dreamer | 402 | Whitespotted greenling | 578 |
| Smoothhead sculpin | 614 | Widow rockfish | 482 |
| Snake prickleback | 982 | Wolf-eel | 1034 |
| Snubnose blacksmelt | 122 | Yellow Irish lord | 662 |
| Soft sculpin | 866 | Yellowfin sole | 1166 |
| Southern rock sole | 1158 | Yellowmouth rockfish | 538 |
| Speckled sanddab | 1110 | Yellowtail rockfish | 486 |
| Spectacled sculpin | 730 | | |
| Spiny flounder | 1114 | | |
| Spinycheek starsnout | 774 | | |
| Spinyhead sculpin | 850 | | |
| Splitnose rockfish | 470 | | |
| Spotted cusk-eel | 346 | | |
| Spotted snailfish | 878 | | |
| Spurred hatchetfish | 190 | | |
| Starry flounder | 1186 | | |
| Stripetail rockfish | 546 | | |
| Sturgeon poacher | 830 | | |
| Sunbeam lampfish | 298 | | |
| Surf smelt | 146 | | |
| Tadpole sculpin | 858 | | |
| Tadpole snailfish | 902 | | |
| Tan bristlemouth | 166 | | |
| Thornback sculpin | 694 | | |
| Threadfin grenadier | 366 | | |